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A Consolidation of Engineering and Mining Journal and Mining and Scientific Press

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January 22, 1927

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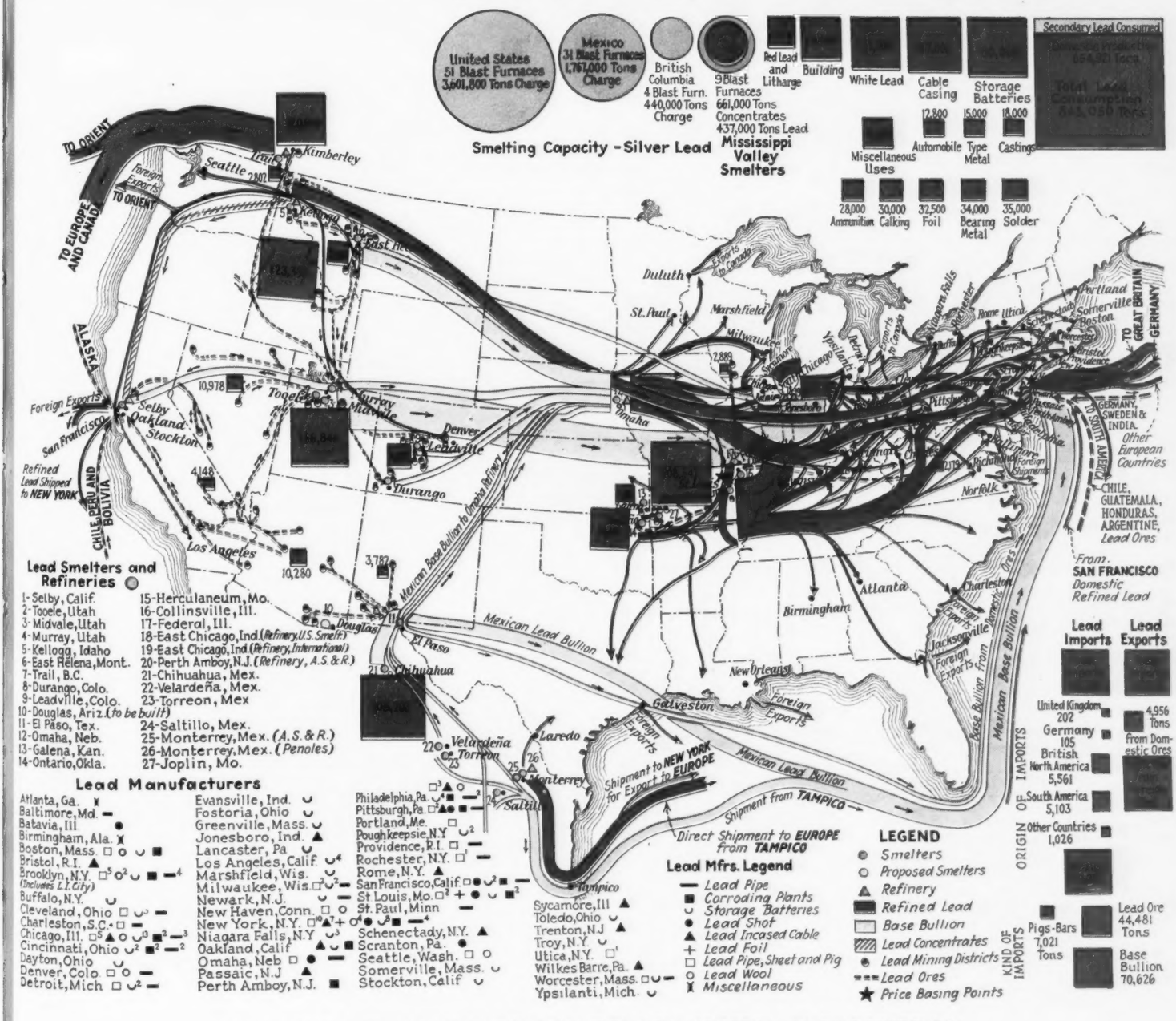
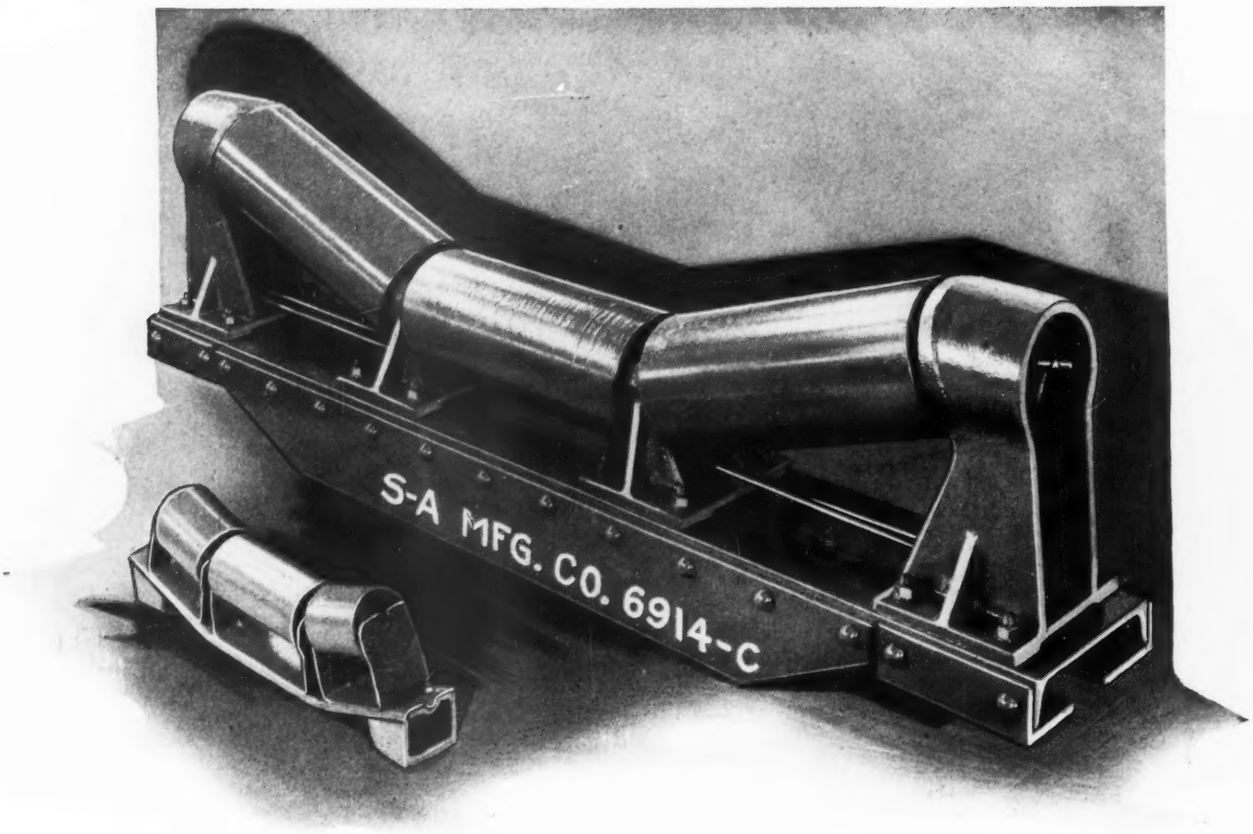


FLOW OF AMERICAN LEAD INTO INDUSTRY

The Lead Chart is based principally upon statistics of 1925, derived from Bureau of Mines, American Bureau of Metal Statistics, and from the lead producers. It is in part quantitative but not completely so. Only primary manufacturing is indicated. From the primary manufacturers and lead refineries, lead is sent in different forms and in varying amounts to practically every community in the country. The crossing of bands arises from the preference given by certain manufacturers to their favorite brands of refined lead.



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Mining practice that

The new methods and processes constantly being developed in the mining, milling, and smelting industries are constantly calling for new and more efficient types of machinery equipment to increase output per man-shift and improve metallurgical recovery.

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1926 REVIEW NUMBER AND YEAR BOOK

ENGINEERING AND
MINING JOURNAL

JOSIAH EDWARD SPURR, Editor

Volume 123 | New York, January 22, 1927 | *Number* 4

Looking Backward and Forward

THE HISTORY OF THE MINING INDUSTRY during 1926 and the outlook for 1927 are closely bound up with industry in general in the United States and abroad. More and more, commerce becomes sensitive to world-wide conditions.

PAST FINANCIAL HISTORY has shown that periods of prosperity and high security and commodity prices have been followed by periods of depression: and for a year or so conservative business men have been on the outlook for the initiation of the decline. It persistently fails to appear; and now the best judgment for 1927 is a continuation of reasonable prosperity. It is claimed that more complete business organization, interlocking of interests, and more flexible use of money and credits remove the major causes of past violent fluctuations.

THE PAST YEAR has been, on the average, a good one for mining. With expanding mechanical industry, there was an increased use in many metals. World production of copper, for example, increased 4 per cent over 1925, itself a year of high production. The copper mine production of the United States increased proportionately. While the price of copper held around an average of 14c. or less, and closed the year markedly weaker, yet this should not be compared with pre-war copper prices in connection with present general commodities prices, as has currently been done, by the miner as well as by the farmer. The true comparison is with the present cost of copper production, permitting relatively lower prices for the metal, which will no doubt be permanent, and which incidentally have encouraged the purchaser to buy more largely.

WHILE COPPER, due to the low price, markedly increased its production, lead production in the world was also a little greater (5 or 6 per cent) in 1926 than in 1925, both in the world and in the United States. The price made the results very satisfactory to the miner, although it averaged ½c. a pound less than in 1925. No superabundance of world lead is in sight; so that a similar condition is likely to obtain for 1927. Zinc production, on the other hand, increased more largely—the world production nearly 10 per cent, the United States production over 13 per cent.

IRON MINING has been active, but competition is keen and profits are nominal. High state and local taxes have handicapped the Lake Superior region and developed competitive sources in the United States and overseas. In Europe the iron industry has been strengthened by commercial treaties and by the formation of trusts and cartels.

PRODUCTION AND CONSUMPTION of petroleum have increased. The report of a government commission shows some six years' supply in sight in the United States, with the more distant future problematical. Conservation measures are being considered, and other sources of fuel oil and gasoline—such as oil shale and bituminous coal—have been investigated and vast reserves acquired by petroleum companies.

GOLD, under the disadvantages of high commodity prices of post-war times, declined slightly in world production. The United States production continued to shrink. The actual production has been attained largely through operating economies and better metallurgy, as in the case of copper. When the limit of economy shall have been reached, commodity prices will probably tend to decline further, to enable a continuation of gold production.

THE SILVER INDUSTRY is the most conspicuous lame duck among the mining industries. The world has plenty of silver, but does not increase its industrial demand for the metal quite satisfactorily. Silver coinage, the main past use of the metal, is becoming old-fashioned: other metal substitutes are increasingly used. Either research and advertising will have to stimulate new uses for silver or the price will remain low.

LOOKING OVER other metal and mineral commodities, we note that increased tariff protection has been asked for barytes, fluorspar, and magnesite. Since all mineral supplies are exhaustible—some in the United States already exhausted, some to be exhausted in a few years, and others at various times in the future—it is doubtful, in most cases, if mineral tariffs are to the best interests of the nation. In many cases where they have been applied they are inefficient: the patient was already too far gone to respond to the artificial stimulation.

THE WORLD is feeling the first sharp premonitions of the approaching exhaustion of tin, reflected in high prices. There is little reason to foretell, in the long run, anything but a greater stringency, though it may be temporarily checked. The future generations will probably gradually accept substitutes, for many of the uses, as the price climbs.

J. E. SPURR.

MINING IN 1926

COPPER *at Lower Cost and Price Levels*

Production and Demand Closely Balanced—Increased Dividends

By Arthur Notman
Mining Engineer and Geologist, 170 Broadway, New York

Arthur Notman

THE year 1926 has marked the return of the copper industry of the world to the pre-war level of prosperity, though at a lower level of costs and prices. So far as North and South America are concerned, there is still excess capacity in existing plants. African production has been handicapped by lack of labor and will be substantially lower than in 1925. The average copper price for the year will be about 13⅞c. per pound. Failure of European consumption to hold up to 1925 figures was offset by record-making domestic takings throughout the year. There seems grounds for hoping that European conditions may improve sufficiently during the coming twelve months to make up for any slackening in domestic demand.

There has been further marked improvement in costs without wage reductions, and it seems probable that the world is satisfying its requirements relatively cheaper than at any time in the industry's history. During the '90s and the early days of the present century, the average price paid for the metal was a little more than a cent lower than the present level, but owing to the high purchasing power of the dollar during that period, the world was really paying substantially more than now. The accompanying tables are based on the reports of the American Bureau of Metal Statistics:

Distribution of World Copper Production

	1924 Per Cent	1925 Per Cent	1926 Per Cent
United States	54.6	54.6	54.0
Chile and Peru	16.3	15.8	15.2
Africa	7.6	7.4	6.8
All other countries	21.5	22.2	24.0
	100.0	100.0	100.0

Note—The 1926 figures are estimated on the basis of the first ten months.

Rates of Increase in World Production and Consumption of Virgin Copper

(Assuming 1923 Production as 100)

	Production, Per Cent	Consumption, Per Cent	Average Price, Cents per Pound
1923	100.0	95.8	14.421
1924	107.7	108.8	13.024
1925	112.1	115.1	14.042
1926	115.1	115.2	13.875
Annual average increase	5.03	5.07	Weighted average price... 13.837

For the four years consumption and production have equaled each other. They are in balance at the moment. Consumption figures are merely productions corrected for changes in stocks. These facts present a formidable argument against any price range higher than 14c. as long as Europe continues to lag behind the United States in economic recovery and industrial growth. The rate of increase in world production per decade for the hundred years ending Jan. 1, 1921, was 65 per cent, or 6½ per cent annually. For the last three decades of this period the average was 6.37 per cent. The rate of increase of consumption for these periods would be somewhat lower because of the cumulations of unsold stock, which reached a maximum for all time early in 1921. I have not considered the years 1921 and 1922, because they represent a period of drastic readjustment resulting from failure of producers to dispose of their output in 1919 and 1920 while they continued to produce at a high rate and at a high cost. For these reasons I have chosen 1923 as a basis of comparison because it was the first post-war year in which industrial activity in this country at least might be regarded as normal.

When we return to the financial record of the industry, even more convincing evidence is found that it has successfully adjusted itself to the lower level of prices. That portion of the industry in North and South America controlled by United States capital, which produced 1,050,000 tons of copper in 1925, is now distributing interest and dividends to its bond- and stockholders at the rate of $80,000,000 per annum, after giving effect to the resumptions and increases of dividend announced during 1926. This is equivalent to about 3¾c. per pound produced. The actual distributions in 1925 by the companies amounted to $56,000,000 or 3.13c. per pound, whereas allowing for the increased output, the actual rate of distribution for the calendar year 1926 will be about $73,000,000, or 3½c. per pound.

Bond Interest and Dividends Distributed

	Total	Per Pound of Copper, Cents	Price, Cents per Pound
1924	$55,000,000	2.75	13.024
1925	66,000,000	3.13	14.042
1926	73,000,000	3.50	13.875
Present rate	80,000,000	3.75	13.875

The average for the five years ending Jan. 1, 1916, prior to the high prices resulting from the war stimulus was 3.65c. per pound for a group of companies that produced 85 per cent of the production from North and South America. This is practically the same group as that for which the above figures are given. The total output for those five years was 2,875,000 tons. Total distributions were $208,500,000. The annual averages were 575,000 tons and $41,700,000, respectively. Thus this portion of the industry has doubled its capacity and its return in dollars during the twelve-year period. The average purchasing power of the dollar distributed in the pre-war period as measured in 1913 dollars was about 102c. and the present purchasing power is about

70c. Therefore the present dollars distributed are worth about 68½c. measured in purchasing power of the pre-war period. In other words, the American-owned industry is distributing the equivalent of $55,000,000 of pre-war purchasing power. This is an increase of $14,000,000, or 34 per cent of the pre-war rate.

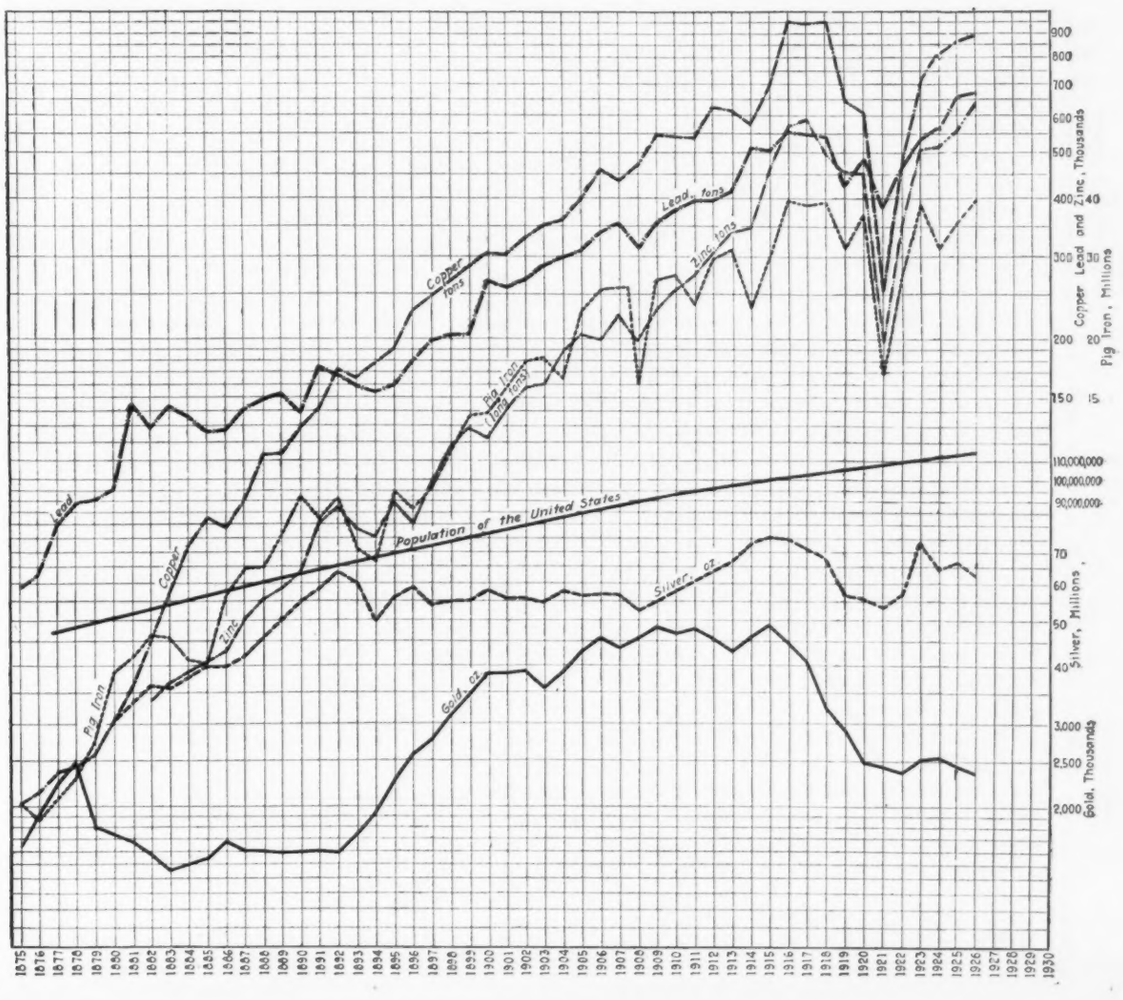
Figures for the remaining 15 per cent of production from North and South America in the pre-war period and the 10 per cent at present would not affect these proportions materially. The present worth of these increased distributions, if it is assumed that there is a fixed limit to the amount of copper to be recovered from the contributing properties, is greater than it would be at a lower rate of output. For example, if a life of twenty years is assumed at the present rate of extraction, or forty years at the pre-war rate, by Inwood's tables, with interest at 7 per cent, it is found that the current worth of $80,000,000 (or $55,000,000 pre-war) is $527,000,000 pre-war, while at the former rate of $41,000,000 annually, the present worth is only $509,000,000. Though these figures have no absolute value and are merely relative, it is not difficult to believe that the owners of the industry are actually more prosperous now than they were in pre-war times with copper selling almost 1½c. per pound cheaper.

Comparative study of the present performance with pre-war records reveals the following facts: In the face of a 50 per cent increase in wage rates, a 50 per cent increase in the cost of material consumed, a 100 per cent plus increase in local and state tax burdens, a reduction in the average grade of ore treated, and a reduction of nearly 1½c. in the price received for the product, the operating staff of the industry, backed by intelligent financial management, has re-established the pre-war margin of profit on the business. Everybody concerned can take just pride therein.

One should not draw invidious distinctions, but one is nevertheless particularly impressed with the current performances of both the Utah Copper Co. and the Miami Copper Co. In the former case, the adaptation and continuous development of steam-shovel methods of mining, coupled with oil-flotation concentration, has made it possible to produce perhaps the cheapest copper in the world from ore carrying less than $3 per ton at present prices. In the latter case, it has been demonstrated that by underground mining methods copper can be produced from ores carrying little more than $2.25 per ton at present prices, at a cost that represents a satisfactory margin of profit to the owners. This is all the more striking because of the doubts openly expressed in many intelligent quarters of the solution of this problem.

These are outstanding accomplishments, and, as already indicated, are strong arguments against a higher level of prices relative to other commodities than the present. At the same time, this relative cheapness of the metal has gone a long way to solve the difficulties of expanding its market and preparing the world to absorb the potential increases from Central Africa, South America, and other discoveries yet to be made.

Metal Production of United States 1875-1926



LEAD MINING *in North America*

Increased Efficiency in Operation and Ore Concentration

By Clinton H. Crane
President, St. Joseph Lead Co., New York

Balbach Photo
Clinton H. Crane

NOTHING during the year just passed should cause dissatisfaction to the United States lead miner, manufacturer, or final consumer. Though the average price has been $12 a ton less than for 1925, the ultimate benefit to the producers from the satisfactory tenor of the market, the steady demand, and the general improvement in operating technique may well be equivalent to the immediate and commensurable saving accruing to the consumers. The United States production and that of the world as a whole exceeded by 5 or 6 per cent the previous record figures of 1925. The American consumption far surpassed that during any other year, as, in addition to the entire domestic output, the foreign lead absorbed by the market exceeded the 1925 figure by some 60,000 tons. The stocks of lead in all forms at the smelters remained at a safe minimum for nearly the entire twelve months. The price was highest in January, and after the year's low in May, there was a secondary peak in August, from which there was a steady decline for the remainder of the year, largely due to the sagging of the London market consequent upon hand-to-mouth buying by English and Continental manufacturers.

In the three major lead-mining districts, Southeast Missouri, Utah, and Idaho, the wage scale and the cost of living at the close of 1926 were little, if any, different from those of the year before. The variations in the prices of coal, coke, powder, steel, and other operating staples were negligible. Thus the economic position of the miner during 1926 was equivalent to that in the previous year, but the lower lead price resulted in a smaller margin of operating profit, except where offset by changes in grade conditions or by better mechanical and metallurgical practice.

There were few developments of note in the "lead-belt" of Southeast Missouri. The production came entirely from three companies and totaled about 2 per cent less than for 1925. An interesting feature was the installation by the St. Joseph Lead Co. of a selective flotation plant for the recovery of zinc, which is contained to a small extent by part of the ore of the district, but to save which there has been no previous attempt. The Tri-State field enjoyed a prosperous year and produced slightly more lead than ever before.

In the Utah section the most important metallurgical advance was the construction of selective flotation mills by the United States Smelting, Refining & Mining Co., and by the International Smelting Co. at Tooele, both of which are operated as adjuncts to the smelters, which can now pay for the zinc in sulphide ores, instead of penalizing the shippers as heretofore when the ores were treated directly in the blast furnaces. This change has made commercial many ores that were previously considered worthless and has materially increased the receipts at both plants. In addition, the Silver King Coalition, the Chief Consolidated, and the Utah Apex properties are now equipped with their own selective flotation plants, which ship lead concentrates to Utah smelters and zinc concentrates either to Texas or to the electrolytic plant at Black Eagle, Mont. Development in the Park City, Bingham, and Tintic districts has been normal, and the results have maintained or increased the ore reserves. It was not until the latter part of the year, when the price of silver depreciated so materially, that there was any noticeable curtailment in the ore production of the region.

The major occurrence of the year in Idaho, and perhaps in the United States as a whole, was the discovery and development of a large orebody at the Livingston mine, in the Saw Tooth Mountains. This is undoubtedly the biggest single lead strike in recent years. Although the property is many miles from any railroad, a considerable tonnage of antimonial silver-lead concentrates is now being shipped.

In the Cœur d'Alene, the Hecla Mining Co. started fine grinding and all-flotation treatment of its coarse tailings. A new flotation mill was installed at the Galena mine of the Callahan Zinc-Lead Co., and at the Morning mill of the Federal Mining & Smelting Co. jig and all other gravity methods were replaced by straight differential flotation, resulting in high recoveries of both lead and zinc. The Sullivan Mining Co. commenced the construction of an electrolytic zinc plant, using the Tainton method, which is expected to prove a great adjunct to the present flotation work in the district. The Morning mine completed the sinking of its shaft to the 3,050-ft. level, and the Bunker Hill & Sullivan Mining & Concentrating Co. finished sinking to its No. 19 level, 2,000 ft. below the Kellogg Adit tunnel. The Bunker Hill smelter was in continuous operation on a two-furnace basis and probably produced slightly more lead than during any other of its ten years' operation. The output of the Cœur d'Alene was about the same as that for 1925, which was approximately 126,663 tons.

The Canadian production, which as usual came nearly entirely from the Consolidated Mining & Smelting Co., Ltd., exceeded that of 1925 by about 20 per cent. Development of the Sullivan orebody proceeded steadily, as did additions to the plants at both Kimberly and Trail.

In spite of somewhat uncertain conditions in Mexico, the year's lead output was approximately 220,000 short tons, or 8 per cent more than during 1925. The El Potosi Mining Co., at Santa Eulalia, increased its mill capacity by 50 per cent, making a daily total of 900 tons. At Parral, the milling facilities of the Compania Minera Asarco, S. A., were enlarged in a like ratio.

The Compania Minera Peñoles, S. A., constructed 300-ton selective flotation mills at Mapimi, Durango, and at Veta Grande, in the Zacatecas district. At Guadalupe, Zacatecas, the Compania Internacionale Mexicana, S. A., completed the changing of its cyanide mill, which formerly operated on the ores of the Cantera mine, into a 700-ton gravity and flotation mill, which was specifically designed to treat the lead carbonate ores from the company's property at Bilboa, which are brought in on a newly constructed narrow-gage railway.

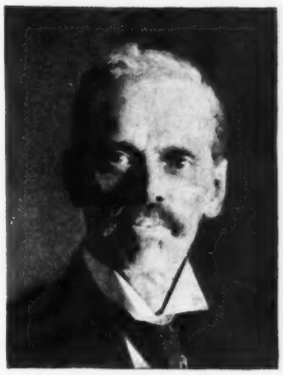
While the immediate business outlook is not dazzling, since steel production is dropping sharply, the automobile industry is largely shut down, and commodity prices show a wide tendency to sag, it is generally expected that the coming year will be one of normal prosperity in the lead-mining industry.

ZINC MINING *Shares General Prosperity*

Tri-State Maintains Supremacy—Western Mines Increase Production

By Arthur Thacher
Consulting Engineer, Security Building, St. Louis, Missouri

THE LAST YEAR has been one of great industrial activity. All records have been broken in manufacturing, transportation, and in power production. This has been brought about through a greater production per man and a greater power consumption per capita. Though prices have not increased materially, and in many cases decreases are noted, still, owing to more effective and increased production, profits have been the greatest in the country's history.



Arthur Thacher

Increased activities naturally depended on increased mineral production. The mining industries have therefore shared in the prosperity. Manufacturing and transportation, as well as power, consume metals, and we find an increased production and consumption of all our metals, zinc being no exception.

As in the past, our main supply of zinc has come from the Tri-State district. Production shows a material increase over the record for 1925, the district maintained its leadership over all other centers.

There are nearly two hundred zinc-producing mills in the district; over 80 per cent have been constantly at work. Prospecting has been vigorously pushed, with satisfactory results. Pessimistic views of a few years ago that this district was to have been short-lived have hardly been borne out; for, even with increased production, new prospecting brought in about as much available ore as has been extracted. At present probably more ore is in sight than at any time in the district's history, this condition being likely to continue for many years. As was to be expected, more capital was attracted and ore was made available which the small operator was unable to utilize. Through consolidation and larger-scale operations, mining methods are being improved. Great advance has also been made in milling practice, a marked change from the older and more primitive methods having taken place. The U. S. Bureau of Mines contributed largely in this development, but individual operators are entitled to great credit for their progressive attitude in adopting new and better methods. With larger available orebodies and increased production from single units it has been possible to make more extended use of flotation, and a larger ore proportion is derived from fine material. Naturally, smelters were not keen for this finer material and at first it did work a great hardship on them, but good work at the smelters has largely overcome the difficulty, so that at present it is not such a serious drawback. On the whole, the smelters have been in better condition than during the last few years, as the "spread" has been higher, and with the improvements that they have been able to introduce their prospects are brighter than for many years.

During the last year the old Joplin district revived and is now contributing an appreciable amount to the supply. Prospecting is also under way, and there is no doubt that the future will show increases and that we can look for a good tonnage from this camp.

The second large source of zinc is in the Northwest and is derived from a number of districts, the ores of which are treated at the Anaconda electrolytic plant at Great Falls. Anaconda has increased its equipment and maintained its position as the leading electrolytic plant of the world. There is no sign of any diminution of the ore supply, as this comes from a number of districts, most of which have prospects of long life, and we are likely to see a growing production here. The situation is helped out by the fact that most of the ores carry considerable content in other metals.

In the East the great Franklin mine of the New Jersey Zinc Co. maintains its unique position. Most of the product is made into high-grade oxide, but a large amount of high-grade "Horsehead" metal is produced from willemite. In New York State the St. Joe Lead Co. purchased the zinc mines at Edwards and took over their operation. In Wisconsin there has been little change, the production being about the same as in 1925. Though present conditions do not seem to afford encouragement enough for more active operations, there are orebodies in the Wisconsin district which in the future are likely to be worked more vigorously. Through the Middle West, a considerable amount of zinc ore was mined in 1926, and no doubt this amount will be increased, but as it is more profitable to utilize this ore for zinc oxide, the metal situation is not affected thereby.

Exports have kept up, although these consist both of metal and ore. The demand for zinc ore in Europe has been very great, for it is wanted to keep the works running as well as for the acid which it indirectly supplies. It is unfortunate that smelting should be done abroad. This condition will no doubt change.

In the rest of the world, Australia is still the greatest source of zinc ores. Part of the Australian ore is smelted and the rest is shipped to Europe. A noteworthy occurrence in 1926 was the taking over of the Silesian mines and furnaces by the Anaconda Copper Mining Co. No doubt these properties will be vigorously operated. Apropos of this, there are a number of localities in Europe which have attracted the attention of operators. With capital and more modern facilities there is little doubt that these deposits will be capable of supplying a substantial amount of zinc.

Increasing industrial activity provokes an increasing demand for zinc. This is well shown in this country. Naturally, the European situation has been bad, for most European countries have been slower in getting started. However, though 1926 in itself does not look promising, still, comparing it with previous years, the advance has been remarkable, and an increasing activity can be anticipated.

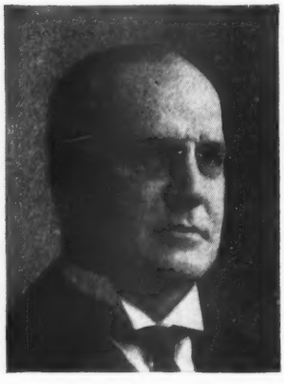
On the whole, the last year has been one of great prosperity, there being nothing in sight that would indicate a slowing down.

GOLD AND SILVER *World Production Increases*

Plea for Greater Monetary Use of the White Metal

By Sidney J. Jennings
Consulting Mining Engineer, 57 William St., New York

MINING of gold during 1926 proceeded with an unusual degree of smoothness and regularity. The output for 1926 will show a small decline over that of 1925, possibly as much as $1,000,000, bringing it down to $389,000,000. The gold-mining industry of South Africa was characterized by continued and increasing efficiency, which brought about an output estimated at $204,000,000, or approximately $6,000,000 more than for 1925. The final liquidation of the Robinson Gold Mines, which for many years was the outstanding producer of gold of the world, brings to mind with renewed force the fact that the production of gold from the Witwatersrand is at some time coming to an end. The time when that end arrives is being hastened by each increase in current output.



Sidney J. Jennings

Increase in efficiency also brought about decrease in mining cost. The probability that a still further decrease in working costs can be affected through the spur of necessity attracted renewed attention to the possibility of profitably mining reefs carrying approximately three pennyweights of gold per ton that lie to the south of the main reef. The efforts of those who seek to beneficiate these low-grade ores will be followed by all interested in gold mining.

Production of gold in the United States during 1926 will not show much variation from the 1925 total of $47,956,991. Alaska will show a slight increase, but the production in the rest of the United States will probably show a decrease of an equal amount.

Canada will have another marked increase in gold production. The limitation of crushing capacity in the Porcupine district due to a lack of power has been abrogated to a large extent. Production during 1927 of gold-bearing copper ore in the Rouyn district will also augment Canadian gold production. With its large mineral-bearing areas still unexplored, Canada offers most favorable opportunity to increase gold production, which will tend to mitigate the anticipated decrease in South Africa and the United States.

Russia will again show an increase in gold production. Possibility of material increase from this country exists; but foreign capitalists continue to manifest such marked distrust of the Soviet Government that development of the mineral resources of Russia is still very slow. Australasia and India declined in gold production during 1926 compared with 1925. No important discovery of gold ore has been reported from any other country, and it is estimated that 1926 production from countries other than those mentioned will be about the same as in 1925.

SILVER MINING

A price above 65c. an ounce stimulated silver mines for the first six months of 1926. The combined effect of the civil war in China, the fears aroused through a misapprehension of the effects of recommendations contained in the Report of the Royal Commission of Indian Currency and Finance, and the selling by France of the silver purchased from its nationals resulted in a marked recession in the silver price, bringing it as low as 51½c. per ounce in October. The effect of this price decrease was most markedly felt in Mexico, where production for the last quarter of 1926 will show a marked decline. Production in Canada increased, as did also production from South America. I estimate that there will be a net increase in silver production during 1926 over that of 1925 of approximately 3,000,000 oz., which would bring 1926 production to about 245,000,000 oz., the highest production of silver for any one year.

Future outlook for silver is not clear. A large proportion of the silver produced is a byproduct in the recovery of copper, lead, and zinc. Such silver will continue to be produced in increasing quantities irrespective of the price. The amount recovered is dependent upon the demand for copper, lead, and zinc. The silver price, however, vitally affects production of silver from ores in which the principal value is silver itself. A price of 51c. or less will make it difficult for many silver mines to operate profitably.

The evidence given before the Royal Commission on Indian Currency and Finance is illuminating as to divergent views upon the possibility of using silver as a crutch to help gold as a basis of value. Under the lead

of England, nations are making an increasing demand for gold as a basis of value. It is natural that finance ministers of the British Empire, which in 1925 produced 70 per cent of the gold of the world, should favor gold as the sole basis of value. Demand for this metal, thus fostered, may easily become greater than can be supplied. Two courses would be open: the first to increase the amount of paper issued against the gold; the second to use more and more silver as a secondary reserve and for subsidiary coins.

Increasing of the amount of paper issued against gold may not be dangerous in peaceful or prosperous times; but in times of stress people learn that the fatal defect of a representative circulating medium is that the person who owns the paper is quite different from the person who holds the value; and in their alarm they make demands for actual gold, which quickly precipitates a crisis. If, on the contrary, silver is used as a supporting secondary reserve to gold, the money that "makes a sound" will in time of stress be preferred to the money that only makes a crackle; and silver will be used in sufficient quantities to absorb increased output.

The gold monetary stock of the world at the end of 1924 (according to the admitted incomplete statistics of the Director of the Mint) totaled $9,699,896,000. At the end of 1925 this gold stock amounted to $9,603,759,000, an apparent decrease of $96,137,000. In the same year the world produced $394,003,335 of gold. Thus a total of $490,140,335 apparently was consumed in the arts or hoarded. Though figures for any one year cannot give a correct arithmetical picture, figures over a term of years give a reasonably true concept of actual tendencies.

During the eight years ending with 1924, according to the figures of the Director of the Mint, the world's monetary stock increased $2,214,871,000. During the same period the world produced gold valued at $2,910,629,385. Thus all but $965,758,385 of the eight years' production was added to the monetary stock. Of this amount lost to the world as a foundation for credit, India absorbed $618,000,000, or 88 per cent. This is at the rate of $77,000,000 per year, but during the last year this rate was apparently very greatly increased. During this same period India imported 766,384,565 oz. of silver more than she exported. This is at the rate of 95,798,070 oz. per year. The eight-year interval included the war, as a result of which India imported more silver than she could conveniently absorb.

It is probable that unless the liking for gold of the Indian people is artificially stimulated, the age-old preference of a dark skinned race for a white metal will have its accustomed influence. If natural preference is allowed full sway and finance ministers take a reasonable view of the possibilities of the use of silver as a subsidiary reserve, the increasing production of silver can be absorbed and its price will be maintained at such a level as to make this needed production profitable.

LAKE SUPERIOR *Iron Mining Uneventful*

Tonnage Large, Demand Good, Profits Nominal

By Dwight E. Woodbridge
Mining Engineer, Duluth, Minnesota

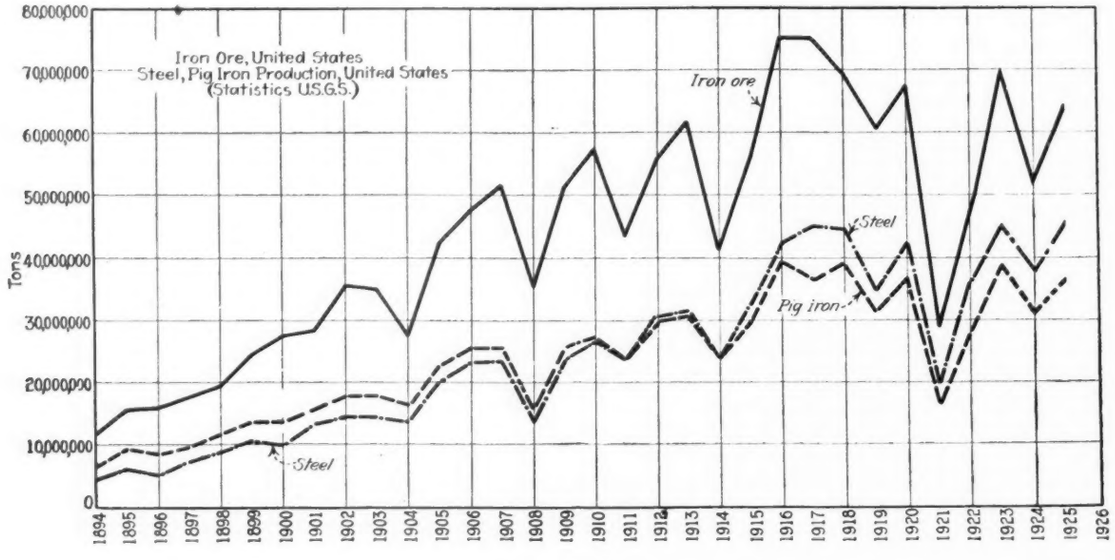
ASIDE from one or two developments, 1926, among Lake Superior iron mines, was uneventful. A few new mines are being opened, and winter operations are normal. Tonnage units handled are increasing, and the use of electricity and labor-saving devices is being extended. Tax costs remain excessive, and with one exception accident records have been bettered. Grades remain constant. The elimination of the independent miner has reached practical consummation; profits have been immaterial, and tonnage has been large and demand good.

D. E. Woodbridge

Under the leadership of its new president the Michigan College of Mines has awakened to the depletion of high-grade ore reserves and has originated a program that will make the college an important research organization. The Minnesota School of Mines, with Cuyuna as its chief present problem, has in operation a similar plan. Minnesota studies pertain to smelting, leaching, and the general metallurgy of manganiferous iron ores. Results do not warrant enthusiastic predictions; with the solution of one problem another advances to the front. It has not been too difficult, for example, to secure high manganese, but phosphorus becomes troublesome. A work of great importance is under way, and it is in hands appreciative of its difficulties and possibilities. Additional financing will be asked of the state legislature this winter.

In Michigan, Dr. Hotchkiss's program includes publication of information already accumulated; getting money to carry on economic geologic investigations that shall aid prospecting; and study and experiment toward elimination of undesirable elements in lean ores, such as silica, sulphur, and the like. By all this he hopes that vast ore reserves, now useless, can be developed soon enough to avert a decline in the mineral industry of Michigan when shipment of present commercial ores diminishes. Much time will elapse before satisfactory answers to these questions can be found, but those who have most to do with the investigations are confident that such answers will result, if the two states realize the importance of the work.

There is activity in the development of highly siliceous ores in Michigan. Ores assaying in the 30's in both iron and silica are now used in quantities equivalent to 1.5 per cent of total shipments. The Hanna company and the Maitland have produced most. In 1926 both companies sold ores at the lower lakes at about $2.50 a ton. Open pits are now under development near Palmer, these being Volunteer, Richmond,



Empire, and Ogden. Hanna, Pickands-Mather, Cleveland-Cliffs, and Quinn are engaged in this work. Generally speaking, ores from these deposits run from 30 to 37 per cent silica and from 35 to 42 per cent iron, and make an ideal fluxing material for some furnace mixtures.

On the Gogebic, the Montreal mine responded to an extensive development campaign conducted by Oglebay, Norton & Co., and has entered the million-ton class for the first time. Its shipment was 1,033,000 tons in 1926. Sunday Lake, long ago regarded as about through, came back vigorously and has a brilliant future. The Gogebic continues to justify the high regard in which it is held, and general developments along the range are decidedly interesting.

On the Mesabi, large pits are being opened by the Oliver, Pickands-Mather, and the Cleveland-Cliffs. Susquehanna, reopened last winter by the Hanna company, and thoroughly electrified, made a high record of shipment—528,000 tons for the season. Nine mines of this district produced in the season just passed more than a million tons each, Missabe Mountain leading with 5,676,000 tons. Of the nine, seven are Steel Corporation properties, a fact that might be elaborated into quite a story. This company's washed-ore shipments show a marked decline.

Cuyuna produced more than since 1923, and prospects are favorable for further growth. Both Oglebay, Norton & Co. and Cleveland-Cliffs have become operators there. A large tonnage of good ore has been developed under Rabbit Lake by Pickands, Mather & Co., and will be opened at once. Ore still goes from this district to St. Louis furnaces, but under heavy freight charges, which may be decreased by the development of the Mississippi River. Mahnomen, with 380,000 tons, was leading shipper for the year. Much is hoped from the Wilson Bradley experiments in leaching manganiferous ores for the production of chemical manganese, and from other investigative work. Figures give proven tonnage of manganiferous ores at about 28,000,000 tons, of which 84 per cent is high (above 0.1 per cent) in phosphorus.

Between Barnes-Hecker and American-Boston mines of the western Marquette, the Ford Motor Co. is developing a small orebody called the Blueberry. Both mines first mentioned collapsed and were flooded, the Barnes-Hecker on Nov. 3 last, with the loss of fifty-one lives. Blueberry is to sink at once 1,000 ft. and 500 more soon after. The company will have a surface layout differing from others. All its above-ground activities —shafthouse, office, laboratory, garage, dry, engine and boiler houses, and shops—are to be under one roof, a steel and brick building now going up. Installations will be electric and permanent from the start. Only one forty-acre tract has been drilled, the orebody being narrow and deep and lying in a trough between a north-pitching dike and the slate footwall. Subsequent exploration is expected to disclose ore extensions. The mine will not ship in 1927. The Ford company's Imperial produced only 108,000 tons in 1926, and is supposed to be nearly done. Every effort is being made to recover the bodies of the men killed at Barnes-Hecker, but it need surprise no one if this task is found too great to be reasonably continued. Several of the larger companies are carrying forward programs in modernizing equipment at many mines throughout the region. Old Lake Superior mine, active since 1857, is scheduled for important increases in output.

The Minnesota Tax Commission found it necessary to reduce valuations on ore, to an extent already of more than $10,000,000. No change of heart is indicated; merely an inability to find as much ore to tax as in the preceding year. Such diminutions will be continuous and progressive, because under present methods there is no incentive to develop mines until they are to be operated. In criticizing Minnesota taxation, the state, it should be noted, is not the only offender. The mining villages, with their reckless extravagances, are chiefly to blame for existing conditions for reasons best presented in the following table:

Municipality	Population	—Tax Collected in 1926— Totals	Per Capita
Hibbing	17,000	$4,829,000	$284
Chisholm	9,000	1,200,000	135
Eveleth	7,000	1,542,000	220
Buhl	2,000	922,000	461

A year ago, in this review, I put probable Lake Superior iron-ore production for 1926 at approximately sixty million tons, contrary to most expectations of that time. When all returns are in the foregoing estimate will be found to have exceeded that figure by about one-tenth of 1 per cent. Predictions for 1927 are not so easy; the consensus of opinion now is that the coming year will about equal that just past.

PETROLEUM *Output Increases Slightly*

Changes in Alignment of Principal Producers

By Arthur Huber Redfield
Bureau of Mines, Department of Commerce, Washington, D. C.*

Arthur H. Redfield

BOTH in the United States and in the world at large petroleum production in 1926 increased comparatively little over the record for 1925 so far as would be indicated by the information now available. As in former years the United States dominated the world situation, producing 71 per cent of the total. Mexico, with diminishing yield, and Russia, with increasing output, continued to occupy second and third places respectively. Venezuela, with almost doubled output, rose to fourth place, ahead of Persia, and Rumania forged ahead of the Dutch East Indies. Altogether, eleven countries furnished over 98 per cent of the world total. Among them was Colombia, a newcomer in the ranks of the leading producers.

The world's production (see accompanying table) increased from 1,067,566,000 bbl. in 1925 to about 1,095,000,000 bbl. in 1926, or about 2¼ per cent. A 21 per cent loss in the output of Mexico was counterbalanced by marked gains in Venezuela, Colombia, Russia, and Rumania and by smaller gains in other countries.

In the United States, according to eleven months' figures of the Bureau of Mines, plus an estimate for December, the total amount of crude petroleum transported from producing properties in 1926 may be estimated at 767,000,000 bbl. If allowance is made for oil consumed on the leases and for differences in producers' storage at the beginning and end of 1926, all of which in the past averaged about 1 per cent of the whole output, the total amount of crude petroleum raised to the surface in the United States in 1926 should be approximately 775,000,000 bbl. This constitutes an increase of not quite 1½ per cent over the 763,743,000 bbl., which, according to the final figures of the Bureau of Mines, the United States produced in 1925. Decreases in the output of California, Wyoming, and Arkansas were offset by increases in the production of Oklahoma, Kansas, Louisiana, Montana, Texas, Colorado, and New Mexico, as well as by small gains in the Appalachian states.

Imports of crude petroleum into the United States were about 60,000,000 bbl., as compared with 61,824,000 bbl. recorded by the Bureau of Foreign and Domestic Commerce in 1925. Of the 1926 imports about 67 per cent came from Mexico, 20 per cent from Venezuela, and 5.8 per cent from Colombia.

In Mexico the decline in the output of the Northern heavy-oil fields, from 78,430,526 bbl. in 1925 to about 58,000,000 bbl. in 1926, was even greater than that of the Southern light-oil fields, whose production went down from 37,084,174 bbl. in 1925 to about 33,000,000 bbl. in 1926.

In Russia, 8,142,000 metric tons (58,538,000 bbl.) of crude oil was produced in the three principal districts during the operation-year ending Sept. 30, 1926, as compared to 6,957,000 metric tons (50,018,000 bbl.) during the preceding operation-year, an increase of over 17 per cent. Of the oil produced in the year ending Sept. 30, 1926, about 67 per cent came from the Baku district and about 30 per cent from the Groznyi district.

World's Production of Crude Petroleum

	1925 *a* Thousands of Barrels	1926 *b* Thousands of Barrels
United States	763,743 *c*	775,000
Mexico	115,515	94,000
Russia	52,448	60,000
Venezuela	19,687	37,000
Persia	35,038	36,000
Rumania	16,646	23,750
Dutch East Indies	21,422	22,000
Peru	9,164	11,000
British India	8,000	8,500
Poland	5,960	6,000
Colombia	581	5,000
All other countries	19,362	19,750
Totals	1,067,566	1,095,000

a Official figures, compiled by L. M. Jones, U. S. Bureau of Mines. *b* Estimated. *c* Bureau of Mines.

Of the Venezuelan production, which in 1926 almost doubled that of 1925, the La Rosa pool furnished the greater part, with Mene Grande as a good second and El Mene as a fair third. Smaller amounts were obtained from Ambrosio, La Paz, and Concepcion, and from Guanoco, in eastern Venezuela.

An event of the year was the discovery in August of the Lagunillas pool, lying about midway between La Rosa and Mene Grande, which yielded from August to September over 1,000,000 bbl. As in 1925, there was still shut-in production in the Rio Tarra and Rio de Oro fields, southwest of Lake Maracaibo.

The gains in the Rumanian production, though general, were greatest in the Moreni field, district of Prahova, and in the Gura-Ocnitzei and Ochiuri fields of the district of Dambovitza. The two districts of Prahova and Dambovitza together supplied nearly 95 per cent of the entire Rumanian output of crude. As a result of the increased production, prices of crude petroleum dropped, and many small producers without refining facilities were compelled to sell their crude at prices which did not cover the cost of producing the oil. On the other hand, the Rumanian refining industry, hampered by imperfect methods which do not give the maximum yield of the higher-grade products, and by high freight rates to the ports of export, suffered under foreign competition.

In Persia, the Anglo-Persian Co., which completely controls production, has planned for the fiscal year ending March 31, 1927, a total output of about 4,750,000 long tons (36,351,000 bbl.), as compared to 4,578,429 tons (35,038,000 bbl.) in the preceding fiscal year.

The petroleum production of Poland (Galicia)

*Published by permission of the Director, U. S. Bureau of Mines.

advanced but little. As in 1925, fully three-fourths of the entire production of Poland in 1926 came from the Boryslaw-Tustanowice-Mraznica field, in the Drohobycz district.

The most striking event of 1926 is the rise of Colombia from an insignificant place near the bottom of the column to a place in the first rank of producing countries. The opening on July 1, 1926, of the Andian National Corporation's pipe line, 360 miles long, from the Infantas oil field to the port of Cartagena, furnished at last the badly needed transportation facilities and for the first time permitted the Infantas field to produce at something like its normal capacity. The first tanker, the "T. J. Williams," cleared from Cartagena for New York on July 4, 1926, with a cargo of 87,500 bbl. of crude oil, and before the end of the year more than 3,500,000 bbl. of Colombian crude load entered the United States. Production of crude petroleum in Colombia is believed to have exceeded 5,000,000 bbl. in 1926.

Minor Industrial Metals

Alloy Group—Platinum—Quicksilver—Antimony—Arsenic—Bismuth—Radium Group—Uncommon Ores—Aluminum

Manganese Ore Mining

By Charles Hardy

President, Associated Metals & Minerals Corporation, 100 East 42d St., New York

OUTSTANDING features in the 1926 manganese industry are the Russian situation and the appearance of the Bethlehem Steel Corporation as an active seller of ferromanganese on a large scale. The Russian situation covers the two fields — Georgia and Nikopol. The Caucasian Manganese Mining Co., Georgia, has met with considerable difficulties, according to all reports, in disposing of its manganese ore at profitable prices after paying heavy expenses and royalties provided for in its concession. Production is reported as having been very much curtailed, and according to information received from Europe, no ores have been shipped recently.

The Georgian (Caucasian) ore required for the United States during 1926 was contracted for during the latter part of 1925, additional sales not apparently having been made during 1926; therefore, if any increased production took place since the beginning of 1926, the United States did not absorb it. Russian and German consumers of manganese ore are reported to have been taken care of mainly from the Nikopol field, which is said to have produced in excess of 200,000 tons during 1926. The Nikopol manganese ore was in former years, because of its high silica content, not particularly desired by the steel industry, but apparently it has been possible to reduce the silica content on the one hand, and on the other to induce the steel works to modify their silica specifications.

The Caucasian situation is not yet cleared up, and apparently at this time no sales of magnitude have been made from that quarter. Indian manganese ore has come, therefore, into its own again, and considerable business is reported for Europe at prices of 40c. For a time Indian ore could not find a market at a satisfactory price, and as a result a large transaction is reported for shipment to the United States at a price of 28c. c.i.f. Atlantic seaports.

Gold Coast deposits of manganese have supplied ore again on a large scale and though quality, originally above 50 per cent, is now reported to be around 45 to 46 per cent, the costs of production and transportation are low, and improved harbor facilities have further reduced shipping costs, so that from the point of cost, delivered at Atlantic United States or European ports, the Gold Coast deposits have probably the advantage over all other manganese production.

Brazil again contributed a large quota to the world's supply of manganese ore. Exact figures are not as yet available, but as each major country of production—Russia, India, Gold Coast, and Brazil—can produce an ore which by its characteristics appealed more to one or to another consumer, very keen competition to sell manganese ore does and will continue to exist unless various interests co-operate to establish a more uniform basis. Manganese ore buying, however, is limited to very few concerns—fewer than 50 in the whole world; and as it has been the habit of the manganese consuming groups to insure their supply by taking financial interests in producing concerns, an agreement among the various factors seems to be exceedingly difficult.

In the meantime, new large deposits of manganese ore have been opened up. South Africa and Australia will before long contribute ore of excellent grade to the world's supply at reasonable prices. Again, metallurgy has made sufficient progress to use ores which in former years were not considered to be suitable, and manganiferous iron ore and ferruginous manganese ores are finding more and more application in the steel industry.

The high tariff in the United States, 1c. per pound on manganese in ores over 30 per cent, has caused consumers to investigate sources of supply for iron ores containing less than 30 per cent manganese and they have been successful in this search—to a limited extent; but investigation continues, and it is not difficult to foresee further opening up of orebodies meeting this requirement, thus increasing efforts of major producers to maintain their markets. Keen competition results in ever reduced prices. Manganese ore, however, is at so low a price, the greater proportion of which is represented by producing and shipping charges, that a material reduction can hardly be anticipated, as a point would soon be reached at which production would be no longer profitable.

The ferromanganese situation in 1926 was extraordinary. Except in isolated cases the principal steel producers have been heretofore buyers of manganese ore and have used the ferromanganese produced therefrom for their own requirements. Other companies were supplied by small domestic ferromanganese producers and by large importations from England, Germany, and, lately, from Norway as well. A price basis established by domestic producers ruled. During 1926 the Bethlehem Steel Corporation became an active seller of ferromanganese, and the competition engendered brought prices down from $115 to $80 per ton f.o.b. East Atlantic ports. This great price drop automatically stopped foreign importation except from Norway and Canada. However, during the latter part of 1926 ferromanganese prices gradually advanced, and when this was written sales were being made at $100 for delivery during the first half of 1927.

A late report from England announced the formation of the United Kingdom Ferro Manganese Co., Ltd., which controls agreements between the Central Provinces Manganese Ore Co., Ltd., in India, and with the Darwin & Mostyn Iron Co., Ltd., Dorman Long & Co., Ltd., United Steel Companies, Ltd., and Wigan Coal & Iron Co., Ltd., producers of ferromanganese. As American steel interests secured control of Caucasian manganese ore, West Coast of Africa, and Brazilian ores, and German steel interests the control of the Nikopol manganese field, the English have by the foregoing announcement also secured control of a large manganese area said to be capable of supplying 600,000 tons of manganese ore per annum.

Imports of manganese ore totaled 303,028 for the first nine months of 1926, or an estimated total of 390,696 tons for the entire year, divided as follows: from Soviet Russia in Europe, 130,284 tons; Brazil, 102,748 tons; British India, 19,879 tons, and British West Africa, 35,240 tons. Ferromanganese importations totaled 28,841 tons, of which the United Kingdom supplied 5,536; Norway 11,022, and Germany 243 tons.

Acknowledgment is made of my appreciation for the assistance given to me in the collection of data by J. W. Furness, of the U. S. Bureau of Mines.

Nickel

By Thomas W. Gibson

Deputy Minister of Mines, Toronto, Ont., Canada

MINES of Sudbury, Ontario, produce 85 or 90 per cent of the world's nickel requirements. The quantity of ore raised during 1926, say 1,330,000 tons, was considerably larger than that recorded for 1925, and is over 80 per cent of the quantity hoisted in 1918, the peak year of the war. Matte produced amounted to about 78,500 tons, containing about 39,250 tons of nickel and 23,700 tons of copper. Precious and rare metals were recovered in the refineries at Port Colborne, Ontario, and Clydach, Wales, during the nine months from Jan. 1 to Sept. 30, 1926, as follows: Gold, 2,287 oz., $46,807; silver, 95,257 oz., $60,781; platinum, 5,281 oz., $507,432; palladium, 5,214 oz., $348,434; other metals of the platinum group, 43 oz., $4,012. Total value, $967,466. In its various forms as matte, metallic nickel, oxides, and salts, the output of nickel amounted in value to about $14,500,000 for the full year.

The operating concerns were the International Nickel Co. and the Mond Nickel Co. The former worked the Creighton and Frood mines, and the latter the Levack, Garson, Worthington, and Frood Extension. Hitherto the Creighton mine, containing the richest and largest deposit yet operated, has furnished the bulk of the ore for the International Nickel Co. On more than one occasion it was thought that the bottom had been reached, but new orebodies have always been found, and there is still a large tonnage to be removed. Lately the Frood mine, probably the greatest deposit of all, has been attacked. It happens that part of the orebody is owned by the International and part by the Mond. In the former there is believed to be 100,000,000 tons of ore, or enough at the present rate of extraction to supply the world's demand for seventy-five years. The International is sinking a vertical five-compartment shaft having a cross-section of 16 by 28 ft. 2 in. outside the timbers, which will have an approximate depth of 2,300 ft. The main shaft on the Frood Extension has been completed, the depth being 2,030 ft. Levels are being developed at 1,700 and 2,000 ft., and it is intended to drill to determine the lower extension of the orebody at the latter horizon.

About 10 per cent of the world's nickel comes from New Caledonia, an island three days' sail from the East coast of Australia. Two companies operate the lateritic ores found there, Société le Nickél and Société des Hauts-Furneaux. A general meeting of the former was held in Paris on May 31, 1926, at which it was stated that the production had considerably increased and labor troubles had been more or less overcome, installations for the refining of nickel had been completed within the estimated cost, and electric power would soon be available under a working arrangement with Société le Chrome. Formerly, selected ores containing up to 8 per cent of nickel were exported, but it is probable that in the near future the whole, or part, of the production will be refined into nickel on the island. The exports of matte in 1925 were about 4,800 metric tons; for 1926 they were probably somewhat in excess of this quantity.

Nickel-chromium alloys have been the subject of much investigation. One chief use is in electrical resistance wire and tape, and another is based on their resistance to extreme degrees of heat, not being subject to corrosion, oxidation, or scaling at the highest temperatures. In consequence, they are of great use in the heat-treatment and annealing of steels.

For coinage purposes nickel is well adapted, either as nickel-bronze or the pure metal, and might with economy be used to replace much of the silver now employed for this purpose. Nickel has high electric qualities, and an alloy of iron and nickel called permalloy has greatly multiplied the number of signals capable of being transmitted by ocean cable.

Chromite

By Edward Sampson

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USE of chromite has nearly doubled since before the war. Since 1921 the average increase of the total ore mined as compared to that mined the previous year has been 14 per cent. Total world production for 1926 appears to have been about 340,000 metric tons, which greatly exceeds the previous high records of 1918 and 1925.

The remarkable increase in the use of chromite is due to causes which will have a lasting effect. First is the use of high-grade alloy steels, including chrome steel; second, the increased use of chromite refractories. The tariff on magnesite gave the opportunity for the substitution of tariff-free chromite in basic open-hearth furnaces. Chromite seems to have proved the better refractory, and its use will probably persist. Chromite refractories are being much used in small plants, and though the individual sales are small as compared to those to the steel industry, the aggregate market has much promise.

The principal recent technical developments leading toward increased consumption of chromite are high-chromium steel and iron, and chromium plating, but it is not likely that any of these will effect the chromite market within the next few years.

Several marked changes have taken place in the sources of supply, although Rhodesia's relative position is unchanged, with probably 155,000 metric tons, or 45 per cent, of the world total. In New Caledonia a large American consumer of chemical ore acquired a new mine, built a loading pier, and in 1926 started shipping. For the last few years all or most of the ore from New Caledonia has been going to Europe. The United States has now drawn again on this supply, and the total production in 1926 was probably nearly 45,000 metric tons. Imports of Cuban ore into the United States have continued to increase, bringing the total for the last year near 45,000 metric tons. Greece shows a normal increase.

In India, the Baluchistan output fell off greatly through 1926, and there was little or no activity in Mysore. The Russian output is uncertain. An output of more than 30,000 metric tons for 1925 was reported from official sources. If this very large figure is correct it might be equaled in 1926. Chromite production in the Transvaal, which assumed considerable proportions in 1925, increased to about 15,000 metric tons in 1926. The ore is of low grade.

The most significant development of recent years is the acquisition by actual consumers of mines which will make them independent of the near monopoly which exists in the chromite industry.

Tungsten

By Frank L. Hess

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THE tungsten market was dominated in 1926, as it has been since the Great War, by Chinese ore, and no American mines could have operated without the high duty of about 200 per cent. American production was equivalent to about 1,225 short tons of concentrates carrying 60 per cent WO_3 (but actually ranging from 30 to 72 per cent), against 1,192 tons in 1925. About 130 tons was wolframite, 200 tons ferberite, and 895 tons scheelite. The American steel business flourished, so that the domestic market probably took more concentrates than usual, and most of them were Chinese.

In Arizona a little wolframite and scheelite were mined at several places. In California, the Atolia Mining Co. worked the residual placers at Atolia, using a steam shovel, and the Tungsten Products Co. mined the tactite deposits 20 miles northwest of Bishop, but snow stopped milling on Nov. 29, 1926.

In Nevada, the Nevada-Massachusetts Co., Inc., mined tactite through the year, 8 miles north of Mill City; the General Tungsten Co. concentrated some tactite 12 miles west of Mina, and C. W. Poole re-worked the tailings of the Pacific Metals & Smelting Co. on the east side of the Nightingale range. Alex. Ranson mined scheelite from a vein near Mina.

Near Nederland, Colo., the Wolf Tongue Mining Co., the Tungsten Production Co., the Molybdenum Corporation of America, and a number of lessees collectively produced a little more than 200 tons of ferberite concentrates.

At Lead, S. D., the Homestake Mining Co. mined wolframite from the unique replacement deposits and a little was mined from the Wasp No. 2 claim on Yellow Creek. Both at Lead and at Nederland it is difficult to concentrate the ore to 60 per cent WO_3 without excessive loss.

From Jan. 1 to Nov. 30, 1926, there was imported for consumption "tungsten ore and concentrates" containing 3,090,700 lb. of tungsten, valued at

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$779,341 ($4 per unit) and tungsten contained in tungsten (metal), ferrotungsten, alloys, and compounds amounting to 138,468 lb. valued at $53,548. These items were equivalent to about 3,416 tons of 60 per cent concentrates. Owing to the high duty, tungsten was withdrawn from bond only as needed, so that the sum of the imports for consumption and the domestic production probably approximates the nation's annual use. Allowing for average imports during December, the indicated consumption is approximately 5,000 tons, too large to be supplied from our mines.

There was held in bond Oct. 31, 1926, ore containing 2,179,012 lb. of tungsten (equivalent to 2,258 short tons of 60 per cent concentrates) valued at $483,875 ($3.53 per unit).

Most of the imported ore was Chinese, but a little was Malayan and less Bolivian. Tungsten in wire, ferro, and powder amounting to 26,308 lb., representing only about 35 tons of concentrates but a considerable manufacturing cost, was exported to Nov. 30, 1926.

Prices ranged during the year from about $3.40 to $4.50 plus duty ($7.14). Domestic scheelite sold at from $10.25 to $11 per short ton unit.

Production from Sinhua Mountains near Nan-an-fu, Kiangsi, which forms a large part of the Chinese output, is now coming from comparatively lean quartz veins, as the rich placers of the region are exhausted, and is shipped through Shanghai. Placers are worked in Kwangsi and less in Kwangtung. The concentrate from Kwangsi goes out through Canton and Hongkong.

Shipments from Shanghai in the first nine months of 1926 amounted to 4,388 long tons, probably averaging 67½ per cent WO_3. This is at the rate of 7,370 short tons of 60 per cent concentrates per year. From Canton and Hongkong 426 long tons were shipped from January to June 30, 1926, but nearly all was trans-shipped at Shanghai and is probably included in the figures given for that port. It seems probable, however, that China may have exported an equivalent of 8,000 short tons of 60 per cent concentrates.

It is reported that Burma and the lower Malay Peninsula can produce tungsten ores at present prices only as a byproduct of tin mining. Burma's output is said to have been about the same as in 1925, when it was 653 long tons, but in 1925 a total of 1,561 long tons, which had been pooled and held under government control, was also shipped. Fifty tons remained to be shipped early in 1926. On Nov. 15, 1926, stocks available were 250 tons of cleaned ore and 550 tons of "tinny ore."[1]

Australia and South America have made little production, and the world's output in 1926 probably was about 10,000 short tons of concentrates carrying 60 per cent WO_3.

An advertisement in a New York paper in November offering 50 tons of concentrates per week from Porto Rico caused considerable interest until it was found that no tungsten ore was available from the island.

[1]Charles J. Pisar, American Consul, Rangoon.

Cobalt

By G. C. Bateman

COBALT production of Ontario for 1926 showed a considerable decrease, as indicated by statistics of the Ontario Department of Mines for the first nine months of the year. This report indicates a production of cobalt salts totaling 38,776 lb.; of metallic cobalt, 126,100 lb.; and of cobalt oxide, 188,449 lb., having a total value of $801,254. Corresponding figures for 1925 were 78,565 lb., 268,773 lb., and 423,824 lb. respectively, having a total value of $1,614,000. In addition, there was shipped in the form of unseparated oxides and in ores and residues exported 225,277 lb., valued at $148,779, compared with 285,958 lb., valued at $206,761, for the corresponding period of 1925. This indicates a decline of $870,728 in the nine months. It should be noted that these production figures are not a correct guide to actual mine output, as statistics are obtained from the smelters and not from the mines. The smelter carries large stocks of raw materials on hand, and with a smaller demand, stocks are built up, and with an increased demand, stocks are diminished.

The figures do, however, reflect a decreased output from the mines, brought about by competition from African sources. The Union Minière de Haut-Katanga has its refinery in Belgium in operation and is now marketing the different cobalt products. As a result the Ontario refinery is faced with a smaller demand and is paying less for raw material. In previous years the mines were able to market a low-silver high-cobalt ore and get approximately 3c. per per cent per pound, or 30c. per pound of cobalt, for a 10 per cent ore. This price was paid on the cars, there being no freight or treatment charges. At present producers receive only about 2c. per per cent per pound and have to pay freight and treatment, and as a consequence cannot afford to mine this class of ore. A considerable part of the residue stocks accumulated in the cobalt camp have been sold, and most of the new cobalt production comes from high-grade ores and concentrates. German firms are in the market for ores and residues, and some shipments are being made to Germany from Ontario.

Though not officially stated, it is understood that a selling agreement has been entered into between the Ontario and African interests, which probably accounts for the smaller output of Ontario. The nominal quotation for cobalt metal is about $2.50 a pound, but it is understood that lower prices are given on substantial contracts, particularly to the steel trade, in an effort to increase consumption now that a large and permanent supply of cobalt is assured.

Molybdenum

By B. F. Phillipson

President, Climax Molybdenum Co., New York

A STEADY development in the commercial application of molybdenum, particularly in the steel industry, is to be recorded for 1926. Mining operations were continued throughout the year on a somewhat larger scale than during 1925, although the consumption was still far below the productive capacity of the country.

Except in the case of a few special steels containing relatively high percentages of molybdenum, all molybdenum steel is now made by the direct reduction process through the use of calcium molybdate. A steady growth of molybdenum in the manufacture of steel and iron castings is also worthy of note. The use of molybdenum in conjunction with nickel in the carburizing grades of steel has been an important factor in the general development of the metal in the steel industry, and this type is now being produced in almost as large tonnages as the chrome-molybdenum higher-carbon steels which were the first to gain recognition.

Platinum

By James M. Hill

Engineer, U. S. Bureau of Mines, San Francisco*

STOCKS of the chief platinum metals in the hands of United States refiners at the beginning of 1926 were: Platinum, 44,024 oz.; palladium, 26,740 oz.; and iridium, 3,720 oz. Domestic production of new metal from all sources was about on a par with the record for 1925, and is estimated as 4,000 oz. of platinum, 6,000 oz. of palladium, and 30 oz. of iridium. Imports during the first nine months of 1926 were: Platinum, content of ore, 913 oz.; grains, nuggets, sponge, and scrap, 63,770 oz.; ingots, bars, sheets, plates, and other forms, 25,523 oz.—a total of 90,206 oz. (75,810 oz. in 1925). Palladium, 6,128 oz. (5,405 oz., 1925); iridium, 2,805 oz. (1,866 oz., 1925).

Imports of crude platinum from Colombia, South America, were at the rate of 3,040 oz. a month during the first eight months of 1926, and England sent an average of 2,850 oz. of crude and 1,600 oz. of ingots, bars, sheet, plate, and other forms a month. Total imports from France from January to August, inclusive, were 2,169 oz. of grains, nuggets, sponge, and scrap and 7,695 oz. of ingots, bars, sheet, and plates. Exports of platinum ingots, sheet, wire, alloys, and scrap during the first nine months of 1926 were 8,023 oz., as compared with 11,979 oz. in the same period of 1925.

The market for platinum was good, but all platinum metals decreased in price. Refined platinum, which began the year at $120 an ounce, dropped to $115 at the end of January, $112 in February, reached the low of the year, $108, in May, rose to $114 the first of July, $116 the first of August, and $118 the end of September, but sagged to $112 the middle of October, at which level it remained. Prices of crude platinum followed much the same course, but were $6 to $8 below those of refined metal. Palladium at the first of the year was quoted at $78 to $82 an ounce and remained at those figures until mid-April, then began to drop, reached a low of $67 to $69 in the middle of May, rose to $70 to $72

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in the middle of June, but began to decline again the last of July, and reached $66 to $70 early in September, at which level it remained. Iridium, from a high of $380 to $390 an ounce on the first of January, declined to $275 to $300 the first of March, $200 to $215 the first of May, and to $125 to $135 the first of July, at which level it remained throughout the rest of the year. This decided drop was evidently due to augmented supplies from South Africa and Tasmania. Osmium followed iridium, beginning the year at $110 an ounce, dropped to $85 to $90 in April, to $65 to $75 in July, and to $60 to $65 in October. Rhodium was quoted at $80 to $95 in January, $75 to $85 in May, $70 to $80 from June to October, and at $65 to $75 the rest of the year. Ruthenium was likewise in a declining market, quotations being $95 to $105 in January, $75 to $85 from March to May, $55 to $65 early in June, $75 to $80 for two weeks at the end of June, but $60 to $70 in July and August, and $50 to $60 until early in November, when prices stiffened to $65 to $75 an ounce, but declined immediately to $45 to $50 an ounce.

It has been intimated that world platinum refiners and producers have been endeavoring to come to some agreement for the control of the industry. The jewelry trade is the largest consumer of platinum, and the price of the metal is a large factor in its continued popularity. It has been suggested that augmented supplies from Russia and Colombia, as well as from South Africa, might break the prices to such an extent that the principal market would be greatly reduced, unless adequate control of supplies is maintained, as is done by the diamond producers.

In Canada there was a larger yield of crude platinum from the Tulameen River than for some years, and recoveries from the refining of Sudbury ores were approximately the same as in 1925. In the United States production of crude platinum from the placer mines of Oregon, California and Alaska was practically the same in 1926 as in 1925, when 343 oz. were reported produced. The Salt Chuck mine, in southeastern Alaska, was in operation until fall, producing palladium-bearing copper concentrates.

In Colombia the South American Gold & Platinum Co. was given a decision by the courts, confirming a concession to certain lands on the Condoto, where the No. 1 dredge began operations the last of March, 1926. Plans have been made to convert No. 1 dredge to electrical drive and to install a close-connected bucket line. The British Platinum & Gold Corporation, Ltd., had another accident last year to its No. 2 dredge, which was reported damaged in July. The production of platinum in Colombia in 1926 will at least equal the 1925 yield of 62,000 oz.

Conditions of the platinum-mining industry in Russia have improved, and it is believed that production may have reached as high as 60,000 oz. during 1926. Sale of Russian refined platinum since early in the year has been made only by the Precious Metal Trading Co., Ltd., of Berlin, under the supervision of the Soviet Government. Officially no Russian crude platinum can be sold.

The Adams River osmiridium field, in Tasmania, continues to be productive. In 1925 the yield was 2,933 oz. from this field alone, and the total osmiridium output of Tasmania was 3,365 oz. In October, 1926, announcement was made of the formation of the "Tasmania Osmiridium Producers Co-operative Associated, Ltd.," which will market the entire production, no other buyers being permitted to operate in Tasmania.

In the Transvaal about a third of the thirty-five companies organized to exploit platinum deposits have made any real progress and but two have produced. The Onverwacht Platinum, Ltd., up to Aug. 31, 1926, produced crude metal estimated to contain 3,963 oz. of refined platinum metals since starting its plant in February. The Transvaal Platinum, Ltd., began production in April, and to the end of August had produced the equivalent of 480 oz. of refined platinum metals, when it was decided to close down the mill. Four other mills for treating platinum ores were practically completed by August, and the opinion seems to be that during 1927 at least 45,000 oz. of platinum metals can be produced if the price holds up. Production of osmiridium from the Union of South Africa for the first eight months of 1926 was 4,500 oz.

Quicksilver

By H. W. Gould

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THOUGH the production of quicksilver in 1926 will not show a great increase over the record for 1925 or 1924, nevertheless the figures do not in any way reflect the widespread activity in the industry at present. As predicted a year ago, the price of the metal has continued upward past the $100 mark, being on Dec. 5, 1926, $105 per flask, New York. With metal stocks cleaned up in Europe as well as in this country, the market conditions are better than were ever known before.

Consumption continues at the same high rate of 1925, and, as was the condition in that year, the heaviest increases has been in the electrical trades. Domestic production plus imports shows an apparent consumption of about 34,000 flasks for the eleven-month period ending Dec. 1, 1926. In Continental Europe consumption increased considerably, especially in Germany, but England shows no increase, probably on account of the general strike. Apparently the world consumption is on the increase, as production figures and rise in price show.

Though no trustworthy European production figures for 1926 can be secured, nevertheless it is generally believed that both Spain and Italy are increasing their production. The Spanish production from October, 1925, to July, 1926, is the heaviest on record, being stated unofficially as 46,000 flasks. Assuming Spanish production at this figure for the year 1926, with Italy the same as last year, or about 52,000 flasks, the United States production at 10,000 flasks, and Mexico and miscellaneous at 3,500 flasks, the world's production would total about 111,500 flasks. As no appreciable stocks are on hand, it is apparent that consumption is keeping pace with production.

In Italy the old Idria mine, in Carniola, which formerly belonged to the Austrian Crown, has taken a new lease of life, probably on account of high metal price. In the Monte Amiata district and at Monte Labro production continues about as heretofore. It will be interesting to see what the Almaden mine, in Spain, does during the present season and what, if any, increase is made in production.

In the United States during 1926 there was much activity in the industry; nearly all of the old mines are doing some work or expect to make an effort to produce. What is more interesting, however, is the number of new prospects brought to life in the last year, especially in Washington, Oregon, Nevada, and Arizona. Undoubtedly some of these new deposits will be heard from as producers in the next few years. In California the bulk of production has been made by the old mines, most of which comes from the New Idria. During the year the Cloverdale and New Almaden closed down, but the Aetna mine, in Napa County, started to produce after installing a new 4x60-ft furnace plant. At present over twenty mines or prospects are opening up and developing in California.

In Oregon the Mercury Mining Co., near McDermott, started operations, with a new 4x72-ft. furnace in October. The Pacific Quicksilver Co. is also installing a 2x24-ft. furnace near Princeville, in the same state. Many small mines and prospects are also being worked.

In Nevada, though not much production was made during 1926, many prospects are nevertheless being worked and old mines are being reopened. In Washington the Fisher Mercury Mining Co. installed a 3x40-ft. rotary furnace at the company's mine near Morton and started producing in October. The Barnum-McDonnell property, adjoining, made a fair production all year with a retort plant. In Arizona, the Arizona Quicksilver Corporation is putting in a 4x60-ft. furnace at its Sunflower mine and will be in production early in the spring. The Arizona Cinnabar Co., in the same district, expects to put in a 3x40-ft. furnace this winter. Many prospects are developing, and it is quite possible that Arizona will make considerable production in the next year or two.

In Texas the Chisos mine continues as the largest producer, but it is probable that the current price will stimulate the Texas production during 1927.

At present nearly 95 per cent of the world's quicksilver is produced in the six largest mines—four of which are in Italy, one of which is in Spain, and one, the smallest producer of the six, in the United States. In fact, this country in war or peace is now by far the largest consumer of quicksilver, and is largely dependent at present on the product of

five mines in Spain and Italy; and in both these countries mercury is virtually a government monopoly. The Spanish output of the Almaden mine is now sold to a syndicate, and this syndicate, in agreement with the Italian producer, can dictate any price that the market will stand.

However, the present price will undoubtedly stimulate domestic production, as this country has mines that will produce enough quicksilver to take care of the entire domestic consumption if the price holds at the present level. However, it must be borne in mind that nearly all of the old mines have been closed down for some time and that it takes much time to reopen them, to develop new prospects, and to equip them with plants. The year 1927 should show a considerable increase in quicksilver production.

Arsenic

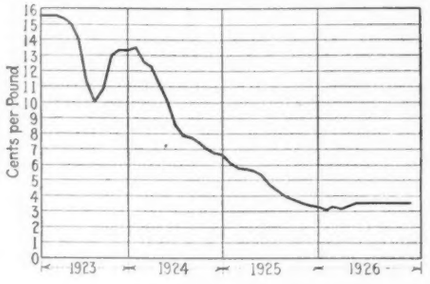
By Hamilton M. Brush

Vice-President, American Smelting & Refining Co., New York

GRADUAL improvement in the arsenic situation took place during 1926; this was manifested by a stabilization in the price following the steady decline of the preceding three years and by a substantial reduction in producers' stocks of refined arsenic, supplemented by a reduction in the stock of arsenical insecticides in the hands of producers and distributors.

Total stocks of crude and refined arsenic held by American producers at United States plants were on Jan. 1, 1926, about 9,800 tons. Corresponding stocks as of Jan. 1, 1927, are estimated to be about 4,400 tons, or a reduction of 5,400 tons. It is estimated roughly that stocks of calcium arsenate in all hands will not be in excess of 2,500 tons on Jan. 1, 1927, as compared with an estimated stock of 10,000 tons on Jan. 1, 1926. This indicates a reduction of 7,500 tons of calcium with an arsenical content of approximately 3,000 tons. With the United States production for the full year estimated at about 5,700 tons and imports at 7,600 tons, this gives an estimated consumption for the calendar year 1926 of slightly over 21,000 tons. Using similar figures, the consumption for 1924 was estimated at 19,000 tons and for 1925 at 20,000 tons.

Because of the fact that so many of the arsenic statistics are gathered more by hearsay and guesswork than by formal reports, the accuracy of these figures cannot be guaranteed, but they are approximately correct and indicate a gradually increasing consumption of arsenic in this country. The accompanying table gives a fairly good picture of the arsenic situation in 1926.



Arsenic price curve, 1923-1926

There was complete discouragement on the part of both producers and consumers of arsenic in the early months of 1926. A considerable tonnage of first-grade arsenic was sold at as low as 3c. per pound, and there were rumors of sales at as low as 2¾c. per pound. After this "distress" arsenic was disposed of, the price gradually worked back to the 3½c. level, at which price very large tonnages were sold. and the market seems now stabilized at that level.

The accompanying chart gives the arsenic price movement since 1923. If charts mean anything, the one given herewith would certainly indicate that the high level of price and wild speculation of the year 1923 accomplished their economic purpose, which was to increase largely the productive capacity to take care of the greatly increased demand for arsenic. There followed the slow, grinding decline month by month during 1924 and 1925. Toward the end of 1925 the economic bottom seems to have been reached, and for practically a year the price has been stable.

There can be no doubt that the present production of arsenic is entirely of byproduct nature. From the fact that, even with only byproduct arsenic being produced, stocks are nevertheless being materially depleted, there is every indication that lower prices need not be expected and there is justification for hopes of moderately higher prices. As to whether these higher prices will come during 1927 depends largely upon the action of the Southern planters in maintaining their use of calcium arsenate in view of the tremendous 1926 cotton crop and low prices for cotton now prevailing.

Although imports of arsenic during 1926 will probably prove to be only some 2,000 tons less than in 1925, the interesting point in connection with imports is that during 1926 these imports have come very largely from Canada and Mexico and consist of byproduct arsenic. Japan, Germany, Belgium, and Greece, which were large exporters of arsenic to the United States during the high-price period, have practically dropped out. Imports from Japan and Germany during 1926 were only about 10 per cent of what they were in 1925.

From the foregoing record it would appear that arsenic had seen its worst days and that we have a right to expect a moderate improvement in the not too distant future.

Statistics of Arsenic Industry

1926	(*A*) Refined U. S. A. Prod., Tons	(*B*) Imports, Tons	Total Arsenic Available, Tons	(*C*) Price per Pound, Cents
January	258	560	818	3.05
February	536	339	875	3.22
March	746	385	1,131	3.12
April	377	433	810	3.41
May	140	533	673	3.50
June	390	1,563	1,953	3.50
July	271	1,656	1,927	3.50
August	495	635	1,130	3.50
September	560	234	794	3.50
October	697	(*D*) 660	1,300	3.50
November	(*D*) 650	(*D*) 300	950	3.50
December	(*D*) 650	(*D*) 300	950	....
Totals	5,770	7,598	13,311	

(*A*) American Bureau of Metal Statistics. (*B*) U.S. Department of Commerce Reports. (*C*) *Engineering and Mining Journal*. (*D*) Estimated.

Antimony

By K. C. Li

President, Wah Chang Trading Corporation, New York

THE ANTIMONY MARKET in 1926 continued the strong position of the preceding year, when stocks were very low, with heavy consumption on account of general industrial prosperity, particularly in the automobile and vehicle business, where much of the antimony used in the manufacturing of storage batteries and babbitt metal is consumed. The market opened in January at 23⅝c. per pound, duty paid (duty 2c. per pound), f.o.b. New York. These high prices, which are precedented only by the war period, encouraged production in China immensely. China has been, since 1912, the principal source of supply and now contributes 80 to 90 per cent of world requirements.

The sudden increase in production caused heavy arrivals in United States ports. According to the New York Metal Exchange, the arrivals in the month of January were 1,474; in February, 1,116; March, 1,452; April, 1,215; and May, 1,428 tons; a total of 6,885 tons for the first five months of 1926, as against 3,347 tons for the same period in 1925 and 4,146 tons in 1924. On account of these heavy arrivals, although consumption was only slightly reduced, the high prices began falling fast. By the end of March the price was down about 18c. duty paid; in April, it was 17c.; in May, 11½c., and in June, 10½c., with fair-sized spot stocks held by dealers and importers which cost them considerably more than the current market—some holders having paid as high as 25c. per pound at the close of 1925. As a matter of fact, forward shipments such as June-July from China were sold in June by distressed holders as low as 7½c. in bond or 9½c. duty paid, although the spot and near-by positions were held at a premium of about ½c.

In July, certain shrewd, perhaps unscrupulous, speculators declared *force majeure* on a big tonnage which they had sold for June-July shipment from China. This unwarranted action caused considerable anxiety to the responsible parties who purchased from them, and made it necessary for buyers to purchase in the open market, which took a sudden jump to 14½c. in July and to 16c. in August and September. At the

end of September and the beginning of October large shipments arrived from Hamburg, which were discovered to have been originally June-July shipments from China, but had been diverted to Hamburg by the same speculators who declared *force majeure* to their original purchasers and manœuvered to sell these shipments at higher prices to "consumers" as shipments from Hamburg. For this reason and because of the continuous heavy arrivals at United States ports of 1,084 tons in June, 1,280 tons in July, 1,145 tons in August, 1,153 tons in September, and 1,213 in October, the market receded quickly to a price of 13½c. in October, 13c. in November and 12½c. at the beginning of December. Production in China in 1926 was even greater than in 1925. It is expected that the total export of China for 1926 will exceed 17,000 tons.

Arrivals in American ports for the first ten months of 1926 were 12,560 tons, which was over 2,000 tons greater than for the whole of 1925 and 5,000 tons over the 1924 arrivals. More antimony is being consumed in the world than heretofore, and the outlook indicates that consumption is not going to be reduced much—yet the high prices of antimony at this period of the year in 1925 can hardly be expected to obtain now. The present greatly increased production, together with low silver prices (silver forms the basis of Chinese tael currency) will check any violent upward movement. The present price of antimony, 12½c. per pound, at the current tael exchange of 57 is equivalent to about 16⅞c. at the tael rate of 77 a year ago. Should there be any decrease in antimony consumption, which is quite possible, we may look for even lower prices of antimony in 1927, but the latest information from China is that the cost of production has increased about 50 per cent and an additional tax may be imposed on this metal, in which event the picture will be changed again.

Bismuth

By F. Y. Robertson

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BISMUTH is a metallic element that was quite familiar to the chemists of the Middle Ages, notwithstanding its frequent confusion with tin, lead, antimony, zinc, and other metals. Its elementary nature was imperfectly understood, but its properties and reactions were quite firmly determined by Bergman, whose description was published in 1753. The principal use of bismuth now is in the form of bismuth subnitrates and bismuth subcarbonates. Alloys of bismuth are also used in the installation of automatic sprinkler systems in office and manufacturing buildings, the metal plugs holding the water in check being of a bismuth alloy which fuses at a very low temperature.

During 1926 the price of bismuth metal was steady at a level of 10s. 6d. Over January and February the price was 12s. 6d. and 12s., respectively; for the remainder of the year it was maintained at 10s. Consumption of the metal has been good, and production has kept abreast of demand, so that prices have been fairly well stabilized. When overproduction occurs, as is often the case, prices recede to such a point that the high-cost producers are forced to close down their plants and retire from the field.

Production of bismuth in the United States for 1926 will approximate closely that of the previous year, which was 300,000 lb. This production has been obtained principally as a by-product from refining of lead ores by the U. S. Smelting, Refining & Mining Co. and the American Smelting & Refining Co. During the last year no new mines have been discovered in the United States which contain ores carrying bismuth contents of a grade sufficiently high to permit of profitable working for the bismuth values alone. The so-called bismuth properties carry low-grade ores, which occur in small deposits, are spotty in character, and rarely contain bismuth in paying quantities.

Under favorable conditions, China would undoubtedy produce considerable quantities of ore running high in bismuth. The continued internal disturbances there have, however, materially reduced shipments of bismuth ore from that country except occasional small parcels of high-grade ores running from 35 to 65 per cent bismuth. The main source of the world's supply, as heretofore, has been Bolivia, although considerable quantities have been obtained from Saxony, Bohemia, India, and elsewhere.

Bauxite and Aluminum

By James M. Hill

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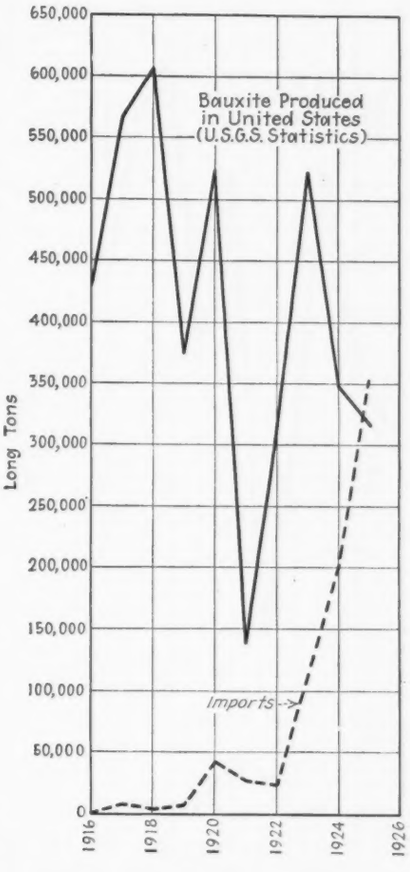
DOMESTIC production of bauxite in 1926 increased somewhat over 1925, in which year 316,540 long tons was mined. The eastern field was not particularly active, but produced chemical ore. Bauxite from the Arkansas field was largely shipped to the alumina plant at East St. Louis. The U. S. Bureau of Mines Experiment Station at Tuscaloosa, Ala., has begun an investigation of the possibilities of beneficiation of low-grade bauxite, of which there are considerable tonnages in the eastern field.

Domestic bauxite, crushed and dried, was quoted at $5.50 to $8.50 a ton from January to the end of July. The form of quotation was then changed to read "No. 1 chemical—5 per cent SiO_2, + 60 per cent Al_2O_3," and the price quoted at $8 a ton for the remainder of the year. Dalmatian low-silica bauxite was quoted at $5 to $6.50 a ton, Istrian bauxite at $5.50 to $7.50, and French red bauxite at $6 to $7.50 a ton throughout the year.

Imports of bauxite for the first nine months of 1926 were 200,769 long tons, as compared with 281,905 long tons for the first nine months of 1925. About three-fourths of the 1926 imports were from South America; the rest from the south of Europe, largely from Dalmatia. Exports of bauxite concentrates for the first nine months of 1926 were 63,361 long tons, compared with 58,496 long tons in the same period of 1925.

French bauxite production was somewhat larger in 1926 than in 1925, but the Istrian deposits were not so productive, because of governmental regulation. The Dalmatian output more than doubled, reaching a total of more than 180,000 tons. Large reserves of bauxite in Hungary are being developed to supply the German aluminum industry.



Domestic production of aluminum in 1926 was greater than in 1925, when the output was valued at $36,430,000. Imports of crude aluminum were very large, indicating a great expansion of demand for the metal in the United States. The automobile industry, which in 1925 was estimated to have consumed 75,000 tons of aluminum, increased its production of passenger cars during the first nine months of 1926 by over 11 per cent, compared with the same period of 1925, to a total of 3,118,461 cars.

The demand for aluminum in the electrical and paint industries expanded and the market for aluminum household utensils was considerably better in 1926 than in 1925. The new Canadian plant of the Aluminum Company of America made its first production during the fall, and increased facilities for aluminum production were under construction in England, France, and Norway. It is reported that an agreement has been reached between German

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and French aluminum makers similar to that in existence previous to the war.

Imports of crude aluminum during the first nine months of 1926 were 27,185 tons, compared with 10,498 tons for the same period of 1925. Imports of plates, sheets, and bars declined from 40.86 tons in the first nine months of 1925 to 19.5 tons in the same period of 1926, but imports of hollow ware were 96.6 tons in the first nine months of 1926, compared with 93.6 tons for the same period of 1925.

Exports of ingot, scrap, and alloys during the first nine months of 1926 were only 248.7 tons, compared with 3,942 tons in the same period of 1925. Exports of plates, sheets, bars, strips, and rods, on the other hand, increased from 1,826 tons during nine months of 1925 to 2,635 tons in the first nine months of 1926. Tubes, moldings, castings, and other shapes exported up to Oct. 1, 1926, weighed 965 tons, compared with 1,423 tons during the first nine months of 1925.

The domestic quoted price of aluminum, 99 per cent pure, remained at 28c. a pound in 1926 until mid-July, was 27 to 28c. until the first of September, and then was 27c. a pound, the same as the 98-99 per cent grade, which was quoted throughout the year at 27c. a pound.

Radium, Uranium, and Vanadium

By Frank L. Hess

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THERE was "nothing doing" in the isolation of radium in the United States in 1926, and as uranium is merely an attendant metal, which some plants threw away when isolating the tiny traces of radium, it likewise attracted little attention. The only radium-uranium ores known to have been mined in this country were mined for making various types of apparatus for introducing radon (emanation) into drinking water, radioactive medicaments, and pads for various ailments. The radium trade is still in the hands of the Belgians, who are understood to have so much radium on hand that it was unnecessary to operate either their African mines or their factory. During the year experiments were carried out on the use of uranium in steel, but results are not known.

Data are not yet at hand showing the world's output of vanadium ores, but it is thought that the world's consumption aggregated 1,500,000 lb. of vanadium.

The U. S. Vanadium Co. operated and enlarged its plant at Rifle, Col., where it treated a roscoelite-bearing sandstone from East Rifle Creek, 11 miles to the northeast. This ore is exceptionally free from impurities. Both fused oxide and ferrovanadium were made, the latter at Columbiana, Ohio. Announcement was made in the fall that the business had been sold to the Union Carbide & Carbon Co. It is said that a large sum of money will be spent in enlarging the plant.

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The Utah Vanadium Co., at Denver, made vanadium oxide from vanadium ores from southeastern Utah, and it appears possible that much more of the ore from the carnotite fields might be used, should the companies give their attention to the matter. Efforts were made to make concentrates of the lead-copper-zinc-vanadates at Good Springs, Nev., but the mill was unsuccessful. New tables are to be installed.

The imports of vanadium ores into the United States from Jan. 1 to Nov. 30, 1926 were:

	Long Tons	Value
British South Africa	21	$3,956
France, (probably Northern Rhodesian ore)	491	46,607
Peru	6,611	841,597

The mines at Broken Hill, Northern Rhodesia, are said to have produced vanadinite actively, and descloizite was shipped from Otavi, in the Southwest African Mandate. It is reported that a large quantity of concentrate is in stock in the country beyond Otavi because the owners were unable to make arrangements with the railroad for shipment. The Southwest African ore largely goes to Germany for treatment.

The Vanadium Corporation of America is said to have developed new methods of concentration for its low-grade ores at Minasragra, Peru, and has thus added largely to its reserves of minable ore.

Vanadinite obtained from the Ahumada mine, near Ahumada, Chihuahua, has not yet been utilized, but a carload of ore was shipped to Bridgeville, Pa., for trial.

The price per pound for the contained vanadium in ferrovanadium carrying 35-38 per cent V as sold by the Vanadium Corporation of America was $3.25 for "open-hearth" grade, $3.50 for "crucible" grade, and $3.65 for "Primos" grade. There has been no market for vanadium ores.

The use of vanadium in steels, other than tool steels, seems to be settling down to the basis that by its use in quantities which leave 0.15 to 0.18 per cent V in the steel, steels can be made quickly and with simple treatment that are equal or superior to elaborately made and treated steels which do not contain vanadium.

Sintered oxide of vanadium carrying 90 to 95 per cent V_2O_5 is being sold for use in glass and as a catalyst in making aniline black. It is said to be also used in making sulphuric acid. It commanded $1.65 a pound in ton lots, and $1.75 in smaller quantities.

Uncommon Ores and Metals

Cadmium—Cerium—Selenium—Tellurium—Thallium Titanium—Thorium—Zirconium

By H. C. Meyer

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CADMIUM, which closely resembles zinc in its physical and chemical properties, finds its chief use in the production of low-fusing alloys and in cadmium plating. This latter use bids fair to become of great commercial importance, and it is said that coatings of cadmium are much superior and offer greater resistance to oxidation than is the case where zinc is used. Furthermore, cadmium does not readily oxidize under normal temperatures and thus retains its lustre, which is not true of zinc, where an objectionable white oxide is produced on exposure to atmosphere under certain conditions. The methods of plating are covered by two patented processes and the plating bath is generally a cadmium cyanide.

It has also been proposed to use cadmium in place of tin in solders. This type of solder was developed during the war and compares favorably with the lead-tin alloy commonly in use. It is hard to see how any large consumption could develop for this purpose so long as the price of tin is less than that of cadmium.

The metal appears on the market in the form of ingots as well as sticks and is of high purity, generally running over 99 per cent cadmium metal. There are about half a dozen American producers. The largest potential producer is the Electrolytic Zinc Co. of Australasia. Cadmium carries an import duty of 15c. per pound. The price remained fairly stationary throughout 1926 at 60c. per pound, although large quantities were procurable at slightly lower quotations.

Large quantities of cadmium metal are converted into cadmium sulphide, which is used as a pigment and also in the glass and pottery industries for the production of orange and yellow oxides. It is an essential constituent in the production of ruby glass in combination with selenium. The prices of the sulphide were considerably lower than those during 1925, ranging from 80 to 85c. per pound in lots of 1,000 lb. and upward.

No statistics are available as to the total production of cadmium metal in the United States during 1926, but it is unlikely that it exceeded that of 1925, which was in the neighborhood of 130,000 lb.

Cerium — No new uses for cerium were developed during the last year. The most important use is in the production of ferrocerium, which is a pyrophoric alloy used in glass lighters, pocket cigar lighters, safety lamps, acetylene lamps, and other like appliances. Cerium metal is a valuable reducing agent, behaving very much like magnesium, but reacting at much lower temperatures than the latter.

To stimulate and widen its use, foreign producers made substantial reductions in their prices, and cerium metal could be had in good-sized lots at around $3.25 per pound, duty paid. The imported ferro-alloy was offered at around $5.25 per pound. Domestic cerium and ferrocerium sold at considerably higher prices. Cerium metal appears on the market in the form of ingots. Ferrocerium is sold in the form of sticks or little billets measuring

about ⅛ in. in diameter and ¼ to ½ in. in length.

The chief source of cerium metal is in the residues remaining after the extraction of the thorium content from monazite sand. From these residues the metal is secured by electrolytic methods and subsequently alloyed with iron and cast into small sticks, producing the ferro-alloy. No statistics are available as to the domestic consumption of cerium and ferrocerium, but it is probably not in excess of a few thousand pounds annually.

Selenium — Selenium and tellurium are two very closely related elements. It seems rather peculiar that a condition has arisen in connection with a new commercial demand for selenium analogous to that developed for tellurium some years ago. We refer to the use of tetraethyl telluride in motor fuel. It was found that the total world production of tellurium would be quite inadequate to meet the trade demand and therefore a substitute had to be found. Subsequent research shows that tetraethyl lead was suitable, and thus a valuable discovery was made practicable.

Early in the present year the research laboratory of a large manufacturer of rubber-sheathed wire cables found that the addition of a small percentage of selenium in the process of vulcanizing produced a marked increase in the toughness or wear-resisting qualities of the rubber. This discovery, if carried to its logical conclusion, would so completely absorb the entire present world production of selenium that other consumers of selenium, principally the glass trade, would have to look for a substitute. Its possibilities in the automobile-tire industry would be quite revolutionary, as it would mean an enormous increase over the present mileage obtainable from the best brands of tires now on the market.

The new use immediately affected the prices of selenium, which early in 1926 was selling for around $1.90 to $1.95 per pound. The prices during the first half on domestic selenium were in the neighborhood of $2 or $2.10 per pound and remained at this figure throughout 1926. Imported selenium sold for around $1.90 to $1.95 per pound.

It is quite apparent that if the new use develops as expected other sources of selenium besides those in the United States must be sought. Sources of supply are known in both Siberia and Mexico, and it would seem that if sufficient encouragement were shown, still other sources could be developed. There is no United States duty on selenium. Besides the new use above mentioned, selenium has been employed for many years in the glass industry both as a decolorizer and as a coloring agent for the production of ruby glass. As the entire domestic production is in the hands of one producer, statistics are not available as to the 1926 tonnage.

Tellurium—The new use for tellurium, which seemed so promising last year—namely, as a colloidal insecticide—did not develop as expected, and there was little demand for tellurium during 1926. Several large lots were offered during the year at distress prices. Good-sized quantities could be bought for around 60 to 70c. per pound.

Owing to the lack of any important demand, only nominal prices have been quoted by producers. These ranged around $1.75 to $2 per pound, but if any real commercial demand arose, much better prices no doubt could be secured

Thallium—There was a brisk demand for thallium throughout 1926. In fact, the demand greatly exceeded the available supply. As there is no commercial ore of thallium, the production is dependent entirely on the accumulation of this metal in flue dust from sulphuric acid plants and certain other smelting operations. Such being the case, it is not possible at present to increase the production except at almost prohibitive prices.

In the early part of 1926 the price was in the neighborhood of $6 per pound, but as the demand increased it rose rapidly, and by the end of the year the metal was selling for around $8 per pound. The largest American producer withdrew from the market early in the year, as his entire output was under contract. Considerable metal was imported, but even the foreign market reflected the shortage, and large lots were very difficult to secure. Most of the metal was converted into thallous sulphate.

Thallium in the form of its various salts is used in electric lamps, glass, photo-electric cells, and for medicinal purposes. A mixture of thallium malonate and thallium formate in the form of a heavy liquid is used for density determinations. In this form it is known as clerici solution and is used for the determination of the specific gravity of minerals. It has a specific gravity of 4.4 to 4.65 and is claimed to be superior to the Thoulét solution, which was formerly used for the same purpose. No statistics are available as to the total world production. The metal resembles lead very closely in its physical and chemical properties.

Thorium—The only commercial source of thorium is monazite sand, which is a phosphate of the cerium earths. The American deposits produced nothing of importance, the chief source of supply being Brazil and India. Brazilian monazite carries approximately 6 per cent thorium oxide, whereas the Indian runs 8 per cent or better. Indian monazite is available in large tonnages at around 7c. per pound. There is no tariff on monazite sand. Germany continued to be the principal producer of thorium nitrate. This salt sold at about $2.25 per pound, which figure includes the United States duty of 35 per cent ad valorem. A small percentage of metallic thorium is added to tungsten used in manufacturing filaments for radio tubes. It increases the electron emission.

Titanium — Titanium finds its principal use in commerce as the oxide and also as a ferro-alloy. There are only two industrial ores of titanium—namely, rutile, the natural oxide, and ilmenite, an iron-titanium oxide. Although there are several potential sources of rutile, only three localities are being worked—those in the states of Virginia and Florida and in Norway. In the Virginia deposits the rutile is disseminated through a rather complex rock, from which it is separated by crushing and concentration. In Florida it is separated from beach sands, where it is associated with quartz, ilmenite, and zircon sand. In Norway it occurs scattered in small grains through a feldspathic rock.

Rutile appears on the market in the form of concentrates running from 92 to 94 per cent titanium oxide. The most important industrial application is as a pigment in the paint and ceramic industry. It produces browns and yellows which are stable at high temperatures. It is also used to a small extent in the coloring of artificial teeth. In this form it is sold under the trade name of "Titanellow."

Ilmenite is the most abundant ore of titanium, and deposits are being worked on a commercial scale in Canada, Virginia, Florida, Norway, and India. The deposits in Canada and Norway occur in massive or lump form. The Virginia, Florida, and India deposits occur in the the form of a black sand. In the massive mineral the titanium oxide content runs from 30 to 35 per cent, whereas in the black-sand concentrates it runs from 45 to 50 per cent TiO_2.

Commercial applications of this ore are increasing. Ilmenite is used for the production of ferrotitanium and pure titanium oxide. Ferrotitanium is used in the metallurgical industry as a scavanger or deoxidizer in open-hearth steel. A great deal of interest has been shown in the pure oxide or "Titanalba," as experiments have shown it to be a very stable white pigment. It is used in the pure form running 98 per cent TiO_2, and also mixed with barium sulphate and zinc oxide as a patented compound.

Prices on ilmenite and rutile were steady throughout 1926, ilmenite concentrates in carload lots ranging from $10 to $20 per ton and the lump or massive mineral being procurable at considerably lower figures. Rutile ranged from 12 to 15c. per pound for both the Norwegian and American products. No statistics are available as to the exact production of either ore during the year.

Zirconium—There are only two commercial ores or zirconium—namely, the natural oxide, sold under the trade name of Zirkite, and the silicate or zircon. The only commercial deposits of the former are those in Brazil. They are of considerable extent. Zircon is found in many parts of the world, the most important commercial sources being India, Brazil, and Florida. In all three localities it is procured as a by-product in the electro-magnetic concentration of beach sands, carrying in addition to this mineral monazite and ilmenite. Zirkite carries 75 to 80 per cent ZrO_2, some grades running as high as 90 per cent. Zircon carried 60 to 62 per cent ZrO_2.

The chief commercial use of Zirkite is as a refractory for lining and patching furnaces where high temperatures are encountered.

The price on Zirkite in carload lots, in finely ground form, was around $50 per ton throughout 1926. On zircon the price ranged from $60 to $75 per ton. On a specially refined grade quotations were higher. The pure oxide ranged from 35 to 50c. per pound, depending on the quantity and purity of the product.

Industrial Non-Metallic Minerals

Asbestos—Mica—Graphite—Talc—Silica Group—Clay Group—Barytes—Gypsum—Magnesite—Flourspar—Fertilizer Group

Asbestos

By Norman R. Fisher

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ALTHOUGH returns for 1926 are still far from complete, it is apparent from those already to hand that the asbestos industry in general enjoyed a highly satisfactory year, with the Canadian results much on a par with those of 1925, and the African a record for all time. Canadian output for 1926 will be near 265,000 tons, of a gross value of about $8,800,000, compared with the record output of 1925, which amounted to 273,522 tons, worth $8,976,645. The fact that Canadian output has not increased, as has been its wont for some years, would indicate that demand for raw material has ceased to expand for the time being. But it is common knowledge that actually more asbestos was consumed by manufacturers in 1926 than was used in the previous year, by drawing upon stock purchased in 1925, before completion of the merger, in anticipation of higher prices. The situation generally suggests, nevertheless, that if a further marked increase in consumption is desired, either new uses will have to be found for asbestos, or the present ones must be broadened through more intensive educational propaganda by those directly interested, whether producers or manufacturers.

Rhodesia, which has extensive deposits of chrysotile asbestos similar to that found in Canada, is the chief asbestos-producing center of Africa. The deposits were known and sporadically worked in a small way previous to the war, but it was the high prices and exceptional demand induced by it that stimulated intensive development and exploitation at the time, and permanently established the industry. Thus in 1914 the Rhodesian output, though a record to that date, was only 487 tons, valued at £8,612. In 1915 it jumped to 2,010 tons, valued at £32,190, and ever since has continued to rise by leaps and bounds, until the 1925 output reached 34,430 tons, valued at £766,381. Returns so far available for 1926 indicate a still further advance of substantial proportions to about 38,000 tons of a gross value of about £900,000.

At present only higher grades of asbestos are shipped from Rhodesia, as is evident from the fact that the product averages about $115 per ton, compared with about $33 per ton for the Canadian. On completion of the 60-mile spur line now being built to connect the principal mines of the field with the trunk line to the seaboard, a marked reduction in this high average may be looked for, because it should then be possible to ship profitably to the world's markets a cheaper grade of material than is now practicable, owing to prohibitive transportation costs.

The Union of South Africa is also an asbestos producer. Its mines are situated both in the Transvaal and the Cape, and will together produce in 1926, judging from returns so far available, about 16,000 tons, worth about £235,000. This is a marked increase over the record of 1925, when only 10,161 tons, worth £152,115, was produced. Part of the Transvaal and all of the Cape production consists of a variety of asbestos known as crocidolite, which has a peculiar blue color and physical attributes that render it more desirable than the chrysotile variety for certain manufacturing purposes. Africa exported in 1926 a total of about 54,000 tons of asbestos, having a value of about $5,500,000, compared with Canada's output of 265,000 tons, worth about $8,800,000. As, however, about half of Canada's output is produced and consumed by manufacturers operating their own mines, it can readily be appreciated that the African asbestos industry has won a strong position within less than a decade of intensive mining activity.

Cyprus, now next in importance as a producer of asbestos, was off the shipping list until May, 1926, owing to its mines being actively engaged upon reconstruction work. It has, however, since been producing and shipping at the rate of about 1,000 tons per month, and produced about 8,500 tons for the year, which is about double that for a like period previously.

Little of a definite nature is known in this country about the current output of the Russian mines. From all accounts, it is in the neighborhood of 10,000 tons per annum, and, except for what little finds its way into Central Europe from time to time, all of this must be consumed locally. Asbestos is also being mined at many other points throughout the world, including several in the United States, but at none in sufficient quantity to deserve special mention here.

Mica

By J. A. Rogers

Rumney Depot, New Hampshire

FROM SUCH REPORTS as can be had, indications are that 1926 at least kept pace with 1925 in mica production, with perhaps a slight increase and with prices remaining about the same. In fact, prices of mica are subject to little change, and, of all of the commodities used by one of the large electric companies, the prices of mica are more stable than those of any other materials consumed.

In the 1925 production New Hampshire led all the states, producing 62 per cent of the entire output of the United States, producing sheet mica to the extent of 1,120,857 lb. North Carolina produced 592,478 lb. and ten other states 80,530 lb., making a total of 1,793,865 lb. of uncut mica, which was 332,968 lb. in excess of the 1924 production.

Mica is largely produced in North Carolina by a great number of small operators, generally engaged in some other activity, principally farming, and by the feldspar miners, who produce more or less mica as an incident to their feldspar production, whereas the New Hampshire production is principally by two large concerns—the General Electric Co., with mines and shops at Alexandria and Bristol, under the management of George W. McNaughton, and the Standard Feldspar Co., of Rumney Depot, with mines, shops, and mills at Rumney Depot, North Groton, Alexandria, Keene, Orange, Hebron, and Grafton, N. H., at which last-named place the company owns the Ruggles mine, the largest known muscovite mica mine. The Standard Feldspar Co. has also acquired and begun the development of an enormous deposit of mica schist in Vermont, which will be used for grinding purposes and which will come into production in 1927.

Total sales of uncut sheet mica in 1925 recorded an increase of 23 per cent in quantity and 52 per cent in value compared with 1924.

During 1926 New Hampshire operators began to export crude mica to England on a satisfactory basis, which, owing to the fact that England controls East Indian mica, is rather unusual.

Graphite

By Benjamin L. Miller

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IN THE graphite industry there were no new developments of particular importance during 1926. Each of the last five years has shown a progressive advance toward world stabilization, and the industry during the last year has followed the trend toward as complete an adjustment as is often obtained in international mineral products.

There is little to be said about crystalline graphite in the United States. Graphite mining is dead in New York and Pennsylvania; is making no progress toward recovery in Alabama; and only in Texas is there any encouraging prospect. In the Burnett locality, in Texas, the International Graphite Products Co. produced in 1926 a good quality of flake graphite that has been largely sold to the battery trade. The Black Donald Graphite Co., Ltd., was the only Canadian company that produced any graphite of consequence in 1926. Two American companies were active in Sonora, Mexico, although considerably hampered by severe storms that did

much damage to the roads and the railroad and also by fears of trouble with the Yaqui Indians. It is estimated that the yearly production will be about 6,000 tons. This all comes to the United States. Part of it goes later to Europe for manufacture of pencils, but most of it is utilized here for pencils, paints, foundry facings, and greases.

In Ceylon the graphite industry has been declining; many mines have been closed down and others are marking time. The reason for this is the substitution of the electric furnace for the crucible both in steel and brass plants and also the use of larger and larger amounts of Madagascar graphite and proportionally less Ceylon material in the manufacture of crucibles. Ceylon exported 9,000 tons of graphite from Jan. 1 to Oct. 20, 1926.

Madagascar graphite mining continues to be active, and that country now dominates and controls the world's graphite industry. In Europe several crucible concerns use only Madagascar flake and in the United States one company has been doing the same. No other country in the world can compete successfully with Madagascar in products equally well adapted for the particular purpose. There were exported from the country 5,738 tons from January to June inclusive.

Madagascar and Ceylon continue to be the two chief sources outside of North America, although there are several countries where low-grade material is mined for local uses. The best examples of the minor regions are the Pinerolo district of north Italy and the near-by Briancon district of southern France. The product contains about 60 per cent carbon and is used mainly for foundry facings.

Talc

Editorial Summary

MINING and preparation of talc are characterized by a productive capacity in excess of the demand, and there is no efficient means to control production. Talc is used in from forty to fifty industries, but only about six of these industries take the prepared mineral in car lots. Roofing takes about two-thirds of all the ground talc, but absorbs the coarse ground (60 to 100 mesh) product only. Of the fine-ground product, the paper, rubber, and insulated wire and cable producers take fully 80 per cent or more. About three-quarters of the United States production comes from Vermont and New York, but the products of these states are not competitive, in that New York produces a fibrous talc, whiter in color and commanding a higher price than Vermont talc. It is also acceptable to the paint industry; whereas, Vermont talc is not. California is an important producer of the finer grades of talc and also produces some block talc.

One new producer appeared in Vermont, the Central Vermont Talc Mines, Inc., with grinding plant at Moretown, Vt. In New York the W. H. Loomis Talc Corporation developed its No. 1 mine to the eighth level and on its seventh level has a minable width of 100 ft. No. 2 mine has been unwatered and a 20-ft. vein of good mineral exposed. Comparatively little other development in new mines is to be noted.

The volume of business in 1926 was about the same as in 1925, or slightly less. Prices were about the same, but competition was keener. Imports were heavier, the estimated total for 1926 being 25,300 tons (talcum, steatite, and French chalk), against 20,990 tons in 1925, or an increase of slightly less than 5,000 tons. Domestic production in 1925 was 5,684 tons crude; sawed and manufactured totaled 895 tons, and ground 182,256 tons, all having a value of $2,144,017. It is understood that the principal French mines have combined with Italian mines, the objective being an increase of exports to the United States. Foreign plants are modern and fairly well equipped. They have the advantage of low costs. The low exchange on the franc and lire gives foreign producers an incentive to increase their exports. Average foreign wage is one-fifth that prevailing in the domestic talc business. Producers believe that they are entitled to a fair amount of tariff protection—more than is afforded by the 25 per cent ad valorem duty now in effect.

Tripoli

By G. V. B. Levings

Resident Manager, American Tripoli Co., Seneca, Missouri

TRIPOLI marketed during 1926 reached a total of 13,000 tons (of 2,000 lb.), approximately 1,000 tons more than in 1925. The increase was fairly well distributed through both domestic and export business; regarding the latter the increase was largely confined to Continental Europe, conditions in Great Britain not being favorable.

No new outlets were developed during the year, in spite of considerable research activity; the principal uses remain the same as those of 1925.

A noticeable development, due to the marked increase in railroad efficiency, has been the gradual effect of short-term buying in the elimination of former excessively high and low periods of activity. Taking the average monthly tonnage as 100 per cent for each period, the difference between the highs and lows for the years 1920, 1921, 1922, and 1923 was 144.6 per cent; for 1924 it had come down to 77.7 per cent; 1925 it was 48.3 per cent; and 1926 gave the record of 40.9 per cent. This elimination of unnecesarily high and low points has been most beneficial in many respects; evidently it has applied to industry as a whole. If this condition continues it would appear that data used hitherto in forecasting the trend of business are obsolete, and new methods will have to be developed.

Diatomite

Editorial Summary

DIATOMITE, or diatomaceous silica, as it is sometimes called, exhibited marked activity in 1926, particularly in the Pacific Coast region. One important heat-insulation company has acquired a deposit near Lompoc, Calif., and will mine diatomite for its own use as well as for the open market. Use of diatomite in concrete has grown until this outlet promises to absorb a large tonnage. About 3 lb. per 100 lb. of cement is the proportion now the rule. This outlet promises to encourage production from minor properties, and these properties may be expected to seek to extend their markets and thereby increase the stress of competition.

Only a well-financed and well-directed company can hope to engage successfully in the diatomite business, for there are numerous deposits within reasonable distance of large centers of use. Preparation of the material is comparatively easy, but marketing requires an efficient sales organization and persistent effort. There are also marked differences in the properties of diatomite from different deposits, some varieties being more suitable for one purpose than another.

Uses are now well established as a filter aid; a clarifying powder; polish and filler purposes; wall and heat insulation; insulation brick and in concrete mixtures. Research may be expected to discover new uses for this valuable material.

Production for 1926 will probably exceed that of 1925, which was 59,410 tons. Prices were the nominal quotations, and were practically without change during 1926.

Silica

By E. C. Speiden

President, Isco-Bautz Co., Inc. Niagara Falls, New York

OUTSTANDING developments in the silica industry during 1926 were along lines of better qualities and a more comprehensive understanding of the fact that there are many varieties of silica. Just as in recent years there has developed a wider knowledge of coal and of the kind of coal best adapted to a given purpose, so there is growing a wider acquaintance with silica in its different forms and a study of the best kind for each specific need.

Amorphous silica has radically different properties from crystalline silica, and each is best for certain uses. The soft, or amorphous, silica deposits of Tennessee were being further developed during 1926 and the product is being more widely distributed. If it were whiter and purer it would find more extensive use in industry where better grades of amorphous silica are needed.

Silica, in its crystalline form, occurs in many parts of the country in deposits running well above 99 per cent pure. Soft or amorphous silica occurs in its purest natural form in the southern Illinois areas, and deposits there run as high as 99½ per cent SiO_2, there being practically no contamination of alumina or iron. The year 1926 witnessed marked progress among the producers in that section in greater uniformity of milling, and 1927 plans call for still further improvements in process and the introduction of more modern methods with a view to securing a still better product.

Feldspar

By Frank P. Knight
President, Mineral Products Co., Beverly Farms, Massachusetts

SALES of ground feldspar during 1926 are estimated at 225,000 tons. Thirty-five grinding mills contributed to this amount. Given an average capacity of fifty tons per day, and allowing three hundred days of operating to each mill, a total capacity of 525,000 tons is estimated. Thus the prediction made at the close of 1925 has been realized, and the mills generally are feeling the effects of overproduction. An old and large producing company gave up the struggle and sold to the largest company. Several others are having a hard struggle. North Carolina continued the leader in production of crude, contributing approximately 38 per cent of the total ground. Maine and New Hampshire were a close second, with the production of each closely approximating Canada's total of crude. Feldspar is produced in twelve states.

Competition has increased. Price cutting continued throughout 1926, and the year throughout witnessed a "buyer's market." As a partial offset to this, an increasing number of consumers have seen the evils resulting from the sacrifice of quality to price and have been willing to pay for a better article. Some are now requiring an analysis and a screen test with each car. It is believed that this tendency will increase further. The average quality of spar sold has been improved. This seems to be a natural result in a highly competitive market.

An outstanding event has been the installation of a new, thoroughly modern plant in North Carolina. Contrary to that which has been the more general practice, the mill has been placed where the company's mines are easily available, and excessive freight and haulage charges are overcome. A visit to this plant has convinced consumers. Government experts, and others qualified to judge, say that the Tennessee Mineral Products Co. has taken a long step in advance in the mining and preparation of feldspar.

Kaolin—White Clay

By R. T. Vanderbilt Co.
50 East 42d St., New York

DURING 1926 shipments of China clay, ball clay, and other white grades which are produced for sale were in good volume. Shipments from American mines will probably total somewhat under 500,000 short tons for the year. Imports will be somewhat over 400,000 short tons, a total of about 900,000 short tons. This is approximately the same as in 1925.

Profit margin has been particularly small, and neither the mines here nor in England have been earning a reasonable return, if any at all. This is due particularly to the breaking up of the price-fixing association in England, which led to drastic price cuts. Lower grades of imported clay, which compete directly with American qualities, have been selling below cost. Foreign producers have averaged this up by exacting high prices for the better qualities, many of which are not directly competitive with American grades.

An interesting development during the year was the discovery in Texas of a white clay that fuses to a glass at 2,100 deg. F. The change from the clay to glass is accomplished without the formation of gas blebs. The material is a clay having the firing behavior of a feldspar but of high viscosity when melted. As a bond in low-temperature work and as a flux of exceedingly long firing range, the material shows promise in the ceramic field.

An interesting tendency in the domestic business is the increasing production of pulverized clays, which are loaded in bulk in paper-lined cars and thus shipped to the large consumers, who unload them by air-suction systems to elevated tanks, whence they flow by gravity to the mixing systems as wanted.

Production in various states remains fairly constant, with, however, a noticeable increase in South Carolina production. There has also been an effort to standardize and increase production of North Carolina grades. The ceramic industries are the second largest consumers of white clays, and here conditions have been and still are unfavorable, due to the pressure of imports (particularly of cheap table china) and to over-capacity, which has led to part-time operation. The trend toward ivory bodies in the general ware industry is worthy of note.

Consumption of bentonite is increasing slowly, as new users are found, but the product still lacks a demand from large carload users. The material has remarkable absorptive properties, some grades absorbing as much as fifteen times their weight in water.

The outlook for 1927 is for a steady consumption of white clays in slightly larger tonnages and with some increases in price, because of higher costs in England resulting from the coal situation.

Gypsum

By Frank A. Wilder
North Holston, Virginia

GYPSUM mined and quarried in the United States in 1926 will probably not show much increase over the record for the preceding year, though when the figures are compiled they will probably be larger than those of 1925. The great gain in tonnage of that year over 1924 can hardly be duplicated in 1926, though the industry in all of its aspects is in a healthy condition.

Production of gypsum rock for cement mills and calcined gypsum for interior plasters in 1926 was about the same as in 1925. Increases for the year will be found in gypsum specialties, including wall board, plaster-board sheathing, structural gypsum, and gypsum blocks.

The mill of the National Gypsum Co. near Akron, N. Y., began production in 1926. A large part of its output consists of wall board. The gypsum reserves in the Akron district have been extended considerably in recent years, and the National Gypsum Co. claims to have located a valuable body of mineral.

The old mill of the Keystone Plaster Co. at Chester, Pa., has been bought by Canadian interests and completely remodeled. Raw material will consist of gypsum from Nova Scotia, and gypsum imported from that province will doubtless show a considerable increase in 1927. Gypsum wall board and structural gypsum will form a large part of the output of the Chester mill.

Prices for gypsum and gypsum products will average lower in 1926 than in 1925. The price of wall board has been more nearly maintained than that of other gypsum products. Demand for wall board has more nearly kept up with the steadily increasing output of the gypsum mills.

In Germany more than half of the million and a half tons of gypsum produced is consumed in the chemical industry. This promises to become in the course of time a new and important field for gypsum in America. At present little gypsum is required in any of the phases of this industry.

Magnesite

By George J. Young

PRODUCTION of domestic caustic calcined magnesite was less in 1926 than for several years past. As formerly, the principal production was made by California properties. One important producer is operating only one mine out of three, all of which are equipped for production. Imports have increased from British India, which is shipping lump caustic calcined to Brooklyn, N. Y., where it is ground and distributed. A new company has been or is about to be formed in California for operation in the Livermore district. Interest is also being taken in a large magnesite deposit in Lower California, and it is probable that a company will be organized and magnesite shipped to both the Atlantic seaboard and Pacific Coast points. Part of the California production is finding an outlet as dead-burned magnesite.

In dead-burned magnesite for refractory use Austria continues to export sufficient to fill major requirements, although Washington magnesite deposits are now supplying about 25,000 tons per year for this purpose. A much smaller tonnage of dead-burned is produced by California.

Quotations for California grades fluctuated in 1926 from a low of $38 to a high of $45 per ton for Grade A, and closing quotations were $42.50 per ton. Caustic calcined on Eastern seaboard maintained a steady quotation of $40 per ton. Dead-burned sagged in quotational prices from $40 at the beginning of 1926 to $33 per ton at the close. Imports were estimated for 1926 as follows: crude and calcined, 14,268 tons; dead-burned and grain, 84,075 tons. This is above the 1925 quantities, and both 1926 tonnages combined are equivalent to 196,706 tons of crude, against 171,002 tons estimated to be the corresponding figure for 1925. As yet no increase in the tariff on caustic calcined magnesite has been granted and the status of the industry has not changed materially.

Crude Barytes

By S. W. Thompson

Thompson, Weinman & Company, Inc., 52 Vanderbilt Ave., New York

NATURALLY, the total figures of crude barytes production for 1926 are not complete at this time, and each year estimates are based on the previous year's output. During 1925 a total of 228,063 short tons of crude barytes was mined and shipped in the United States, or an increase, over 1924, of 37,739 short tons. The f.o.b. mine price decreased 40c. per ton from the previous year's average. This was due largely to the increased importation of foreign ore. Missouri produced 44 per cent of the total quantity, and Georgia and Tennessee produced most of the remainder. Some ore was mined in Arizona, Nevada, Virginia, North Carolina, and South Carolina, the aggregate production of these states being 14,059 tons.

Distribution of the crude barytes produced in 1925 is as follows:

	Tons
Ground barytes	49,674
Lithopone	145,019
Barium carbonate	4,962
Barium salts and other derivatives	13,692

The outlook for the total crude barytes production of 1926 indicates a marked increase over that of 1925, as most of the large consumers have had their normal output assured during 1926, and if the present ratio continues throughout the year there will be about an 18 per cent increase over the 1925 quantities.

No one can deny the fact that our government holds the key to permanent success or diminished production in the various departments of our business enterprise, as the present tariff does not give protection to the crude barytes producers nor to the manufacturers of the various products derived from barite.

Fluorspar

By G. H. Jones

President, Hillside Fluor Spar Mines, Chicago

AN IMPROVED DEMAND for fluorspar developed early in 1926 and continued in fairly satisfactory volume as a result of a demand from steel companies. The large stocks on hand at some of the mines in 1925 had been well liquidated, and this helped the market situation.

Foreign fluorspar arrived in unusual and increasing tonnages in 1926. At this writing (Dec. 7) government reports, January to September, 1926, showed the largest imports on record, aggregating 51,465 short tons, reports for October, November, and December not being available. If imports continue at the same ratio, the tonnage for 1926 will be about 65,000 tons, or 30 per cent larger than the record for any one year heretofore. This is a menace to the industry which will have to be considered and for which provision must be made.

The Tariff Commission, at the request of some producers, recently investigated the fluorspar situation in the United States. It will probably make a report to the commission some time in January, 1927. It has been determined that abundant deposits of fluorspar are available in the United States both for the present and future. An increase in duty of $2.50 per short ton is asked, which is all that can be obtained under the existing tariff law. Imports from France and Italy have been increasing, and Spain is beginning to ship, claiming a practically unlimited supply available for export.

It is not expected that producers will take advantage of the increase in tariff, if granted, to advance prices, but additional protection would enable them to penetrate farther East than they are now able to do, in that way increasing output and spreading overhead over a larger tonnage. The present minimum market price of $18 per short ton is not profitable to the leading producers.

Domestic producers are carrying on many experiments to recover, if possible, some of the fluorspar which has been going to waste in tailings, and with fair chances of a reasonable success. Fluorspar, as is generally known, is an absolute necessity in the production of basic open-hearth and electric-furnace steel. Research chemists have been unable to find any substitute of equal potency and at anywhere near the low cost of fluorspar.

The outlook for 1927 is fairly satisfactory. No new discoveries of domestic fluorspar worth mentioning have been reported. The leading mines, Rosiclare, Franklin, Lafayette, and Hillside, will continue to produce at subnormal capacity, owing to large imports, but will be materially helped toward increased production if a higher duty is provided.

Crude Borates

Editorial Summary

PRODUCTION statistics for crude borate production in 1926 are not available, and important producers will not release any information. It is probable that about the same amount of crude borate mineral and borax derived from brines were produced as in 1925, when production totaled 113,700 tons, valued at $3,085,660. Quoted prices of borax were lower than in 1925, and toward the close of 1926 the price trend was still lower. According to one producer, there is no such thing as a market price for borax. Customers shop around, and each one makes the best bargain possible.

Two relatively new borate deposits were described. One is in the Kramer district and one near Shoshone, Calif. Both are of the colemanite type and are in Tertiary formations. The West End Chemical Co. made no important additions to its Las Vegas (Nev.) property and resumed work at Searles Lake early in 1926, and since has maintained a steady production from this source. The American Potash & Chemical Corporation has made many improvements in operations at Searles Lake, and so extended its plant capacity that a production of 45,000 tons of crystal borax is expected in 1927.

Phosphate Rock

By H. D. Ruhm

Mount Pleasant, Tennessee

THERE is little of interest to say regarding the phosphate rock situation in 1926. The activities at the close of 1925 pursued the usual course of winter retrogression of production as far as outdoor operations are concerned, with the customary heavy falling off of shipments to the domestic fertilizer trade during February, March and April, while spring shipments of finished goods were in progress.

With the generally unsatisfactory conditions of agricultural interests, there was a moderate increase of inventories to be carried over by fertilizer manufacturers, and a corresponding lessening of active withdrawal on contracts made by this consuming trade which generally holds sway from July to December, but on the whole a satisfactory increase of sales for 1926 will be recorded over those of 1925.

Direct use of raw ground rock without acidulation gave encouraging indications for a large increase over 1925, and by July 1, 1926, orders booked showed 100 per cent increase over those for the previous year. However, heavy floods in the corn-belt region, which is the principal consumer of this material, caused many cancellations during the fall shipping season, so that the amount actually shipped was about 50 per cent increase over the record for 1925.

The heavy increase in lump-rock shipments from Tennessee for manufacture into ferrophosphorus at the enlarged Rockdale plant lasted only a few months, as the plant has shut down to await absorption of its surplus production by an apparently oversupplied market. There have been several transfers of operating and of idle properties in both the Tennessee and Florida fields, but the crust of lethargy that has covered this industry for the last five or six years has not yet actually been broken.

The trend of the market will undoubtedly grow more and more toward the use of unacidulated rock for direct application on the one hand, and to the production of high-grade superphosphate at the mines on the other, and both these lines will fit in with a proper utilization of Muscle Shoals as a fertilizer producer.

Nitrate

By A. W. Allen

Chemical and metallurgical engineer, Valparaiso, Chile

TOWARD the end of 1926 the Chilean nitrate industry had reached a condition of unparalleled depression, neither the government nor the producers being willing to sacrifice income in an effort to stimulate sales, by a lightening of the export tax on the one hand or by a reduction in selling price on the other.

The year witnessed the birth or rejuvenation of the usual number of "inventions," which claimed major attention in influential quarters, effecting

a further postponement of any systematized and comprehensive study of the fundamentals of economical processing. Actual progress was made, however, by individual effort. Excellent pilot-plant results were obtained at Oficina Alemania, Taltal, in the application of a cold-water leaching process developed by Eduardo Angelbeck and his associates, on a low-salt caliche. The grounds of the Delaware oficina of the du Pont Nitrate Co. were exhausted during the year; and the treatment of a million tons of material from a pampa of recognized refractoriness marked the conclusion of the first successful effort on a large scale in Chile to substitute a complete alternative process in place of the standard method. Although adapted to suit the peculiarities of an old Shanks maquina, and in spite of the fact that few of the opportunities for improved result could be taken advantage of, the result has indicated the desirability of recognizing certain basic principles, thereby providing an avenue of opportunity to improve yield and decrease cost in the treatment of normal caliche.

The result of the operation of the Guggenheim plant at Coya Norte is being awaited with interest, as it is likely that governmental inaction in regard to the export tax will persist if a successful demonstration is made. Although the logic of finer crushing and the outside heating of solutions—to mention but two of the more important features—is not likely to be questioned, it is felt by some that the immense leaching vats and the use of a tepid solvent, involving the need for chemical stabilizers and the possible addition of a filtration annex, are unfavorable features. Such disadvantages, however, will probably be offset by the economies possible in the handling by modern methods of raw material and final product. The need for stabilizers is a matter of local interest only; and, whatever the outcome, the result is not likely to affect the technology of the industry as a whole.

Potash

C. H. MacDowell
President Armour Fertilizer Works, Chicago

POTASH IMPORTS for the first ten months of 1926 were practically equal to those in 1925, but bookings for 1927 spring distribution are materially lower than those in hand at this time in 1925. The fertilizer industry is disturbed over the spring outlook, especially in the cotton section, and is proceeding with unusual caution respecting future commitments. Fully 75 per cent of the potash used for crop production is consumed during the first four months of the year. Lowered farm paying power, slow collections, overproduction of acid phosphate, and a consequent disturbed fertilizer price situation contribute to the buyers' hesitation.

Potash prices were advanced during the year—muriate about 4 per cent, sulphate 3 per cent, and kainit 11 per cent. Most of this advance has been absorbed by higher ocean freights. A comparison of present prices with those current in the spring of 1914 shows that muriate today is 7 per cent cheaper and manure salts are 9 per cent lower. The only grade that is higher is kainit, which at present is 7 per cent above pre-war price. Kainit at the advanced price is unprofitable both from the seller's and the buyer's standpoint. In 1913 a total of 465,000 tons of kainit was imported, compared with 182,000 tons in 1925. High ocean and rail freights are forcing the buyers to use more concentrated salts.

The use of potash in the United States for the fertilizer year ending July 1, 1926, was the largest on record. Present indications are that the consumption will be somewhat reduced for the coming season, although the growing demand for higher formula brands containing increased percentages of potash will make up in part for loss arising from a reduction in mixed-goods tonnage.

Search for new potash deposits continues, notwithstanding the overextended mining capacity existing in Germany. The Russian Government reports the finding of alleged immense deposits in the Ural district along the Kama River, which it claims can be exploited at a cheaper f.o.b. cost than recoveries in Germany or France. Spain has exported several consignments to the United States recently. Poland seems to possess desirable deposits, but is lacking in development funds. Italy is producing a small tonnage from leucite. The American Potash & Chemical Corporation has enlarged its California plant and expects during 1927 to have an output far in excess of the 1926 production of 21,000 tons of K_2O as 96 per cent KCl. The U. S. Industrial Alcohol Co., at Baltimore, is recovering about 10,000 tons of 33 per cent K_2O salts yearly.

Congress has appropriated $100,000 annually for five years for potash prospecting through core drilling. This work is to be carried on by the Geological Survey in co-operation with the Bureau of Mines. The Texas-New Mexico field will be the first prospected. Work is expected to start immediately.

Sulphur and Pyrites

By Raymond F. Bacon
Chemical Engineer, Chemists Building, 50 East 41st St., New York

FINAL figures for the production and sales of sulphur during 1926 will not be available until March. However, from present estimates it appears that for the first time in three years the producers of sulphur will mine a sufficient quantity to balance or nearly balance sales. The cessation of operations at Sulphur Mine, in Louisiana, made it necessary in 1924 and 1925 to deplete accumulated stocks by nearly 750,000 tons, or about 25 per cent. The two producers of sulphur in this country seem now to have so adjusted their operating schedules that the present stocks of about two million tons will probably not be further diminished.

At present the two companies using the Frasch or hot water process mine about 99 per cent of the sulphur produced in this country, which has since 1918 supplied over 80 per cent of the world's requirements. This figure in 1925 amounted to 1,850,000 gross tons, compared with the world consumption of about 2,250,000 tons. The indicated figure of production of the American companies for 1926 is approximately 1,850,000 tons, compared with about 1,400,000 tons in 1925.

Sicily in 1925 produced only 208,000 metric tons, and was compelled to withdraw about 47,000 metric tons from surface stocks to fill its total shipments of 255,000 metric tons. In 1926, according to the best estimates, the same tonnage was produced, with expected shipments between 260,000 and 270,000 metric tons, causing a further depletion of stocks. The result of these withdrawals has been to reduce the stocks of Sicily to between 50,000 and 60,000 metric tons, the lowest figure in the recent history of the Sicilian sulphur industry. Just what steps are being taken to remedy this situation, and how far their result depends on the rumored electrification plans of Mussolini, cannot be guessed at this moment.

Of two other producing countries little definite information is available. Chile, it is presumed, maintained its normal annual production of about 5,000 to 10,000 tons, and Japan between 35,000 and 45,000 tons. In the latter case production just balances consumption, this being more particularly true since the price has reached the high level of about 80 yen per ton.

The annual sulphur consumption of the world ranges from 2,000,000 to 2,500,000 tons. The largest individual consumer is the United States, which in 1925 used about 1,200,000 tons, a figure probably a little smaller than final statistics for 1926 will show.

An advance of about $4 per ton in the price of sulphur during the last year has brought it up to about pre-war level, a price still relatively lower than most commodities. The increase has been reflected in greater profits for producers in the United States, and, from recent press reports, has had the effect of bringing about the opening of one of the larger deposits of the mountainous region in the West.

Extensive prospecting operations are being carried on in the Gulf Coast region, and though they can hardly be expected to discover as remarkable deposits as those at Gulf and Sulphur Mine, it is probable that good commercial deposits may be found.

The demand for sulphur gives every indication of holding up, so that the requirements during the first half of 1927 should be equal to those of the same period in 1926.

Pyrite, it is believed, although exact data are not available for 1926, maintained in this country about the same production rate as in 1925. The monthly reports on pyrite imported into the United States, however, indicate an increase of about 100,000 tons over the 276,000 tons brought in during 1925. This increase appears to be the result of greater business activity in all lines, rather than a replacement of crude sulphur in any of the plants that have been operating on that material.

TECHNICAL DEVELOPMENTS

GEOLOGY *Advances Theory of Ore Deposits*

Interest in Chemistry, Physics, and Mechanics of Ore Magmas

By J. Volney Lewis
Rutgers University, New Brunswick, New Jersey

J. Volney Lewis

MARKED progress has been made in the theory of ore deposits, in the wider application of geophysical aids in exploration, and in the geology of the platinum metals. Important contributions have been made to the geology of iron ores, and questions concerning the origin of the Chilean nitrates and secondary enrichment in tin veins have been under discussion. Prospecting, exploration, and exploitation of mineral deposits must be planned in accordance with some conception of their nature, distribution, size and shape. These conceptions constitute a theory of the deposits, whether so recognized or not; and it is obvious that the more nearly this theory accords with the facts the more successful the undertaking will be. Under pressure of the increasing difficulties and responsibilities of exploration, the geologist must perfect his theory by checking every possible hypothesis against carefully observed and recorded fact.

Active discussion and re-examination of a wide range of theories bearing on ore deposits marked 1926, and was stimulated anew by Freeman's hypothesis of double sulphides of sodium and the ore metals. In the meanwhile, renewed and critical examination of mining districts has led in many cases to modification of earlier views. An outstanding example of the value of such work is Prescott's discussion of the underlying principles of limestone replacement in the Mexican province. Geologists have welcomed an extended systematic discussion of ore deposits by the great pioneer and leader in the theory of igneous origin, Dr. J. H. L. Vogt.[1]

Interest continues in the chemistry, physics, and mechanics of igneous magmas and magmatic ores. Lindgren pertinently observes that "free discussion is the key to progress." There has been no lack of discussion—interesting, illuminating, and in excellent spirit. Much of it pertains to, or at least was stimulated by, Spurr's later views. In the forefront stand the contributions on magmas, dikes, and veins, by Lindgren[2] and Spurr[3], in which it appears that differences of interpretation are not so great as formerly supposed. Spurr would assign many classes of veins to the ore magma (veindike) type; Lindgren would include only the pegmatitic group. Lindgren holds that extensive replacements require watery solutions; Spurr attributes them to the work of the more aqueous magmas. And so on. Many of the differences are largely questions of degree rather than kind.

Spurr[4] cites the banding around nuclei of included rock fragments as evidence that they are not residual from replacement, but fragments that were unsupported, except by the ore solution, which must have been dense. Van Soelen[5] holds that angular inclusions generally represent the non-replaced part of a crush breccia, the finely crushed groundmass having been replaced by means of watery solutions.

Magmatic ore deposits are normal results of igneous activity, according to Niggli[6], and inseparable from other phenomena of differentiation and the formation of minerals in the rocks. Hence they are a part of the problem of petrology. From a study of several hundred ore deposits, W. H. Emmons[7] finds that most lodes are definitely related to batholithic intrusions, that they chiefly follow the dioritic stage of differentiation, and that they are closely associated with rocks that are more acid than quartz diorite. The most productive deposits are near the tops and upper borders of the batholiths, and these also show the clearest zonal arrangement of the metals.

Meantime the critical examination and discussion of actual deposits continues. Only a few examples can be cited from an extensive literature. Mitchell[8] finds injected ore at Cananea. Wagner[9] describes all degrees of differentiation in place in the copper-nickel sulphide ores in the Rustenberg district, Transvaal. Stressing the increasing difficulty of finding new orebodies in Mexico, Prescott[10] has published an excellent description of the great replacement deposits in limestone, together with a discussion of the principles governing their form, distribution, and extent. Spurr[11], interpreting the data presented by Prescott, discusses the districts as constituting a typical ore magma province, with the following history: (1) Domical uplift, (2) pre-mineral faulting, generally slight; (3) ore injection; (4) post-mineral faulting. Dikes are injected before, with, or after the ore, or not at all.

A further valuable study of the Sudbury ore deposits is contributed by Phemister.[12] Since the ore solutions effected considerable replacement, he prefers to call them

[1] *Economic Geology*, Vol. 21, pp. 207-233; 309-332; 469-497.
[2] W. Lindgren: *Engineering and Mining Journal*, Vol. 122, pp. 125-133.
[3] J. E. Spurr: *Ibid.*, pp. 134-140.
[4] J. E. Spurr: *Economic Geology*, Vol. 21, pp. 519-537.
[5] J. C. Schagenvan Soelen: *Engineering and Mining Journal*, Vol. 122, pp. 777-778.
[6] Versuch einer natürlich Klassification der im weiteren Sinne magmatischen Erzlagerstätten, by Paul Niggli. Halle, Germany, 1926.
[7] *Mining & Metallurgy*, Vol. 7, p. 263 (abs.).
[8] Graham John Mitchell: *Engineering and Mining Journal*, Vol. 121, pp. 167-168.
[9] Percy A. Wagner: Union S. Afr., Dept. Mines and Industries, Geol. Surv. Mem. 21.
[10] Basil Prescott: *Engineering and Mining Journal*, Vol. 122, pp. 246-253; 289-296.
[11] J. E. Spurr: *Op. cit.*, Vol. 122, p. 296-298.
[12] T. C. Phemister: 34th Ann. Rep., Ontario Dept. Mines, Toronto, Part 8.

hydrothermal, notwithstanding their intrusive power. He also regards the problems of ore genesis and petrogenesis as independent, in contrast with Niggli's view. Reuning[13] finds at the Natas mine, Southwest Africa, transitional pegmatitic, pneumatolytic, and hydrothermal deposits, including several types of calcite-pegmatite veins. Adams[14] has described the graphite mines of Ceylon, where graphite has almost completely replaced original silicate minerals (large pyroxene crystals, feldspars, brown mica, apatite) and has penetrated the walls slightly. No conclusion is drawn, but the assemblage of minerals suggests a basic pegmatite, including the graphite, which is a constituent of many pegmatites and of some other igneous rocks. Ross[15] classifies the replacements in the Saddle Mountain and Banner mining districts, Arizona, as "contact deposits," although some of them are not in zones of contact metamorphism nor associated with secondary lime silicates.

There are many descriptions of orebodies, with some discussion of origin; but some are content to record only the observed facts. This is a fundamental requisite of all geologic work; but constant effort should also be made to organize the knowledge, new and old, into sounder theory for future guidance and the advancement of the science.

Freeman's Hypothesis

The most fundamental hypothesis of the year, concerning ore deposits, comes from the field of chemistry. Freeman[16] gives reasons and experimental data to support his theory that sodium sulphide is the essential reagent in the solution and deposition of the sulphide ores. It forms readily fusible double sulphides with the sulphides of all the ore metals and combines with the gangue minerals to form a liquid magma. These are deposited successively upon reaction with water and carbon dioxide. The common metallic sulphides fuse above 1,000 deg. C.; the double sulphides with sodium fuse below 700 deg.

Spurr[17] suggests that potassium also would always be present. This would further lower the temperature of liquefaction, perhaps below 500 deg., which is approximately that of most ore deposition. He notes also that Freeman's hypothesis coincides with the zonal arrangement of metals and with Spurr's former conclusion concerning the minor rôle of the "mineralizers," including water.

Spurr[18] further suggests the possible application of Freeman's hypothesis to the Kentucky-Illinois fluorite region, which he finds to be a typical ore magmatic district, with the well established sequence: Calcite, fluorite (barite), lead-zinc sulphides. The ore solutions included hydrocarbons, which are less concentrated in the wall rocks and may be magmatic. Fluorine, unquestionably magmatic, is similarly disseminated in the wall rocks. Water cannot account for the deposits. Possibly concentrated alkaline solutions of barium, calcium, lead, and zinc sulphides ascended, with alkaline fluorides and hydrocarbons. About 2,000 ft. from the surface, oxidation formed water and carbon dioxide, and possibly some meteoric water entered. The reactions precipitated barite and calcite, and fluorine later changed part of the latter to fluorite.

Some little-considered constituents of the magma, which may have a bearing on ore hypotheses, are discussed by Lewis,[19] who suggests that methane—found in volcanic emanations and in all igneous rocks—may be the source of magmatic hydrogen, water, carbon in its various elemental forms, carbon monoxide and dioxide, carbonates, and in part other hydrocarbons. Oxidation in the rising magma would increase its temperature and liquidity as the surface is approached. Possibly some petroleums will yield evidence of magmatic origin, in part or in whole.

Localization of Ores

The delicately balanced conditions governing ore deposition are well illustrated in the Randsburg district, California. The deposits are sharply limited at and just below a flat premineral fault zone, as described by Hulin.[20] Uglow and Osborne[21] describe the apparent localization of gold by cobaltite in the Windpass mine, in British Columbia. The mineralization is analogous to that of Cobalt, but gold-quartz ore is dominant instead of silver-calcite. Ross[22] finds the copper deposits near Salmon, Idaho, restricted to definite shoots, with nearly barren rock between. They are replacements in shear zones in quartzitic rocks, and the more open parts are thought to have determined the localization of the ores.

Locke[23] offers evidence that many mineral pipes and stockworks are due to (1) removal of rock by rising solutions; (2) collapse and brecciation of unsupported rock; and (3) deposition of ore and gangue minerals in the brecciated mass. The process is compared to the shrinkage of stopes and to the caving of ground over mines and ore shrunk by oxidation.

Origin of Native Copper

The chemistry of copper deposition is discussed by Wells[24], with special reference to a long series of experiments intended to throw light on the origin of the native copper of Lake Superior. Aqueous solutions were employed up to 350 deg. C. and melts up to 450 deg. Wells concludes that the copper-bearing solutions must be referred to a source that was of a distinctly reducing character. Bleaching of red rocks about native copper is a widespread phenomenon. In experiments, ferric oxide precipitated copper from the sulphide solution, but only in the presence of an excess of sulphuric acid. Alkaline solutions were not tried.

Gilbert,[25] working on the same problem, found the antipathy between ferric oxide and the sulphides best shown in contact deposits, where hematite is generally abundant. Sulphide ore solutions reduce hematite, and, conversely, hematite oxidizes the ore solutions; hence the red rocks remove the sulphur and precipitate the copper as metal. This was the tentative hypothesis of Steinmann (1906) for the deposits of Corocoro, Bolivia. It was adopted by Graton and his associates after investigation of the Lake Superior deposits. From the

[13]E. Reuning: Neues Jahrb. f. Min., Geol., u. Pal., Beilage Bd. 52, Abt. A, pp. 193-264.
[14]F. D. Adams: Bull. Can. Inst. Min. and Met., No. 168, April, 1926, pp. 496-503.
[15]Clyde P. Ross: Bull. U. S. Geological Survey, 771.
[16]Horace Freeman: *Engineering and Mining Journal*, Vol. 120, pp. 973-975.
[17]J. E. Spurr: *Op. cit.*, Vol. 120, pp. 975-977.
[18]J. E. Spurr: *Op cit.*, Vol. 122, pp. 695-699; 731-738.
[19]J. Volney Lewis: Bull. Geol. Soc. Amer., Vol. 37, pp. 148, 149 (abs.).
[20]Carlton D. Hulin: Bull. No. 3 Calif. State Mining Bureau.
[21]W. L. Uglow and F. F. Osborne: *Economic Geology*, Vol. 21, pp. 285-293.
[22]Clyde P. Ross: Bull. 774 U. S. Geological Survey.
[23]Augustus Locke: *Economic Geology*, Vol. 21, pp. 431-453.
[24]Rogers C. Wells: Bull. 778 U. S. Geological Survey.
[25]Geoffrey Gilbert: *Economic Geology*, Vol. 21, pp. 560-577.

study of ores from many localities, in field and laboratory and literature, Gilbert finds confirmation of Butler's view that high ferric oxide at contacts is due to the oxidizing effect of carbon dioxide from limestones. This effect is counteracted where the contact deposits are rich in sulphur.

Wide Range of Platinum Deposits

Previous experience and knowledge of the metals of the platinum group have been well summarized by Kemp[26], who enumerates occurrences in placers from peridotites and pyroxenites, in copper-nickel sulphide ores, in sheared granite, in shales and slates, in lime-silicate contact zones, in tetrahedrite and bournonite in metamorphic limestone, in siliceous copper-gold ores in a crushed zone in dolomitic limestone, in graywacke, and in the iron cap of decomposed gneiss or schist.

The amazing variety of platinum deposits found in the eastern part of the South African shield have been described by Wagner.[27] Here platinum occurs in magmatic sulphide ores, in quartz veins, in norite-peridotite intrusives of the Bushveld complex, in the Great Dike, in granites, in diamond-bearing conglomerates and gravels, in dolerite, in kimberlite, and in eluvial and alluvial deposits. These are associated with all periods of igneous activity from the earliest Archean on. They constitute a great platiniferous belt that cuts indiscriminately across the oldest and youngest geological formations, completely disregarding structures in the more superficial parts of the crust, and constitute a typical example of Spurr's ore canals. Further platinum discoveries are expected along the course of the canal, which also includes the greater part of the South African gold belt. The gold probably followed the same canal and one parallel to it on the east. The platinum deposits extend from Cape of Good Hope through Southern Rhodesia, but are found chiefly in the Transvaal. Newberry[28] has described the platinum deposits of the Transvaal, with special reference to the geology and developments in the Lydenburg and Potgietersrust districts.

Only secondary enrichment can account for the deposits in many of the tin veins of Bolivia, according to Koeberlin.[29] Cassiterite has been dissolved and redeposited at lower levels. No adequate chemical explanation seems available. Besides normal tin veins, there are also veins of tin-silver and silver-lead-zinc, with intermediate gradations. In discussion, the solubility of cassiterite was brought out by Greene.[30]

The bedded iron ores of England and Wales have been described by Hallimond[31], who classifies them as (1) ferrous ores; chamosite and chamosite-siderite mudstones; siderite mudstones; sideritic limestones; (2) ferric ores; ferric chamosite oölites; limonitic oölites; primary hematites; glauconitic rocks (commercially valuable). All are marine or estuarine sediments. The conditions of precipitation and the possible rôles of bacteria and algæ are discussed. The association of the Vermilion ores with intrusives and their various mineralogical characters have led Gruner[32] to a new hypothesis of origin: Intrusives brecciated the Soudan formation; hot solutions, poor in silica and rich in carbon dioxide, leached and replaced quartz by hematite and carbonates and oxidized the ferrous iron in the formation to hematite. Carbonates were later removed, leaving a porous rubble.

The mounting cost and increasing difficulty of finding ore stresses the necessity for perfecting and utilizing every possible aid. Other sciences render important service, but geology must always direct the efforts and interpret the results. Hence geology becomes steadily more essential in all important mining exploration, and progress in its fundamental principles holds out the promise of the future. Mining engineers and geologists are aware of the wide range of physical appliances that have recently been developed and adapted to the needs of geologic exploration. These have been described repeatedly in the literature, and many encouraging results have been attributed to their assistance.[33] Concealed ores have been discovered and tested with the drill; buried structures have been found and verified. The geologist cannot see any farther into the earth, but he is beginning to feel, as it were, with a growing sensitiveness of touch. The utility of these adjuncts is already assured, and great developments are expected. Combination of two methods often clarifies results and aids interpretation.

The airplane and aërial photography are also finding a wider usefulness in reconnaissance and prospecting. Slight differences in visibility or shade of color are much more distinct from the air than at the surface. Such differences in rocks, soils, and vegetation often trace clearly the structures, in the desert or in the jungle. Walker[34] outlines the great program of aërial prospecting for copper in Northern Rhodesia—130,000 square miles to be covered in 160 days.

The results of long-continued researches on leached outcrops as a guide to copper ore, by Augustus Locke[35] and associates, are to appear in book form. This is a forward step. It is also an outstanding testimonial to the intensified search, under the spur of necessity, for more exact scientific methods—geochemical, geophysical, geological. The guidance of leached croppings has already achieved an encouraging measure of success.

In the early stages of a new method or instrument it is not always skillfully applied, and the results are liable to misinterpretation. That caution is necessary in the interpretation of the microscopic characters of ores is shown by Wandke's experiments[36], in which remarkable diffusion effects were obtained by heating polished specimens: (1) Mixing—a bornite-chalcopyrite lattice obliterated. (2) Unmixing—chalcopyrite formed in bornite; magnetite and ilmenite separated. (3) Transformation—pyrite in bornite or chalcocite changed to chalcopyrite. Ore minerals perhaps often contain diffused inclusions of colloidal sizes. The universities and technical schools will do well to note the trend and provide for the thorough training of future geologists and mining engineers in the fundamental principles of chemistry, physics, and mathematics.

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[26]J. F. Kemp: *Engineering and Mining Journal*, Vol. 121, pp. 717-719.

[27]Percy A. Wagner: *Economic Geology*, Vol. 21, pp. 109-134; 243-270.

[28]A. W. Newberry: *Engineering and Mining Journal*, Vol. 121, pp. 719-725; 763-768.

[29]F. R. Koeberlin: *Op. cit.*, Vol. 121, pp. 636-642.

[30]Gerald U. Greene: *Op. cit.*, Vol. 122, pp. 417-419.

[31]A. F. Hallimond: Mem. Brit. Geological Survey, "Mineral Resources," Vol. 29, 1925.

[32]John W. Gruner: *Economic Geology*, Vol. 21, pp. 629-244.

[33]C. A. Heiland: *Engineering and Mining Journal*, Vol. 121, pp. 47-58; Vol. 122, pp. 59-61. E. DeGolyer: *Economic Geology*, Vol. 21, pp. 294-298. Geo. Tuchel: *Mining Congress Journal*, Vol. 12, pp. 731-736. Hans Lundberg: *Op. cit.*, Vol. 12, pp. 737,738; Bull. 327 Geological Survey, Sweden. R. Ambronn: Methoden der angewandten Geophysik. Dresden and Leipzig.

[34]G. L. Walker: *Engineering and Mining Journal*, Vol. 122, pp. 576-578.

[35]Augustus Locke: "Leached Outcrops as Guides to Copper Ores." Baltimore, 1926.

[36]A. Wandke: *Economic Geology*, Vol. 21, pp. 166-171.

MINING PRACTICE *Covers Wide Range*

Recent Books—Open-Pit Equipment—Shaft Sinking—Drilling

By George J. Young
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George J. Young

A NOTEWORTHY publication appearing at the close of 1925 was the Institute's book on Mining Methods. Representing as it does systematic co-operation between the Institute's Committee on Mining Methods and men in operating positions, an invaluable fund of information has been collected. Many of the papers included in the volume have already been published and have been noted in previous annual reviews. The organization of this material is a task of considerable difficulty, but it has been done as well as could be done under the circumstances. The successful conclusion of the committee's work deserves special commendation.

Another book which has been needed is Prof. Walter S. Weeks' "Ventilation of Mines." Professor Weeks has been studying ventilation principles for a number of years and has published many articles which were of value. The book is the final outcome and should prove useful in metal and coal-mine ventilation.

Modern Prospecting Methods Need Research

Prospecting by means of physical instruments concontinues to interest many miners, although the subject is generally confused and the time appears to be ripe for a good deal of disinterested research on the part of responsible scientists. Contributing to the existing confusion is the publication of incomplete accounts of results obtained by newer instruments. Among these is a description[1] of a "radio cameraphone" by its inventor, W. A. Sharpe. Sharpe claims to have discovered the position of the "meteor" at Meteor Crater, in Arizona, by the use of his instrument. Other claims of discoveries are made, but the description of the appliances and methods are too incomplete to be of value. An investigation of another radio instrument was made, but its efficacy has as yet to be determined.

A review of methods—gravimetric, magnetic, seismic, acoustic, and electrical—is given by George Tuchel[2]. He points out their dependence upon boring and upon geological investigation and stresses the effects of structural anomalies.

Hans Lundberg[3], in discussing electrical prospecting, points out the importance of the general shape and character of orebodies and the difficulties of finding small orebodies of the steeply dipping, chimney type. He states that reliable results have been obtained on mineral conductors at depths of 600 to 800 ft. below the surface, and it is now possible by means of the Swedish electrical methods to distinguish between indications caused by solid ore and those obtained on non-commercial disseminations and graphitic schists. He says: "Although sulphide orebodies are most suitable for locating electrically, the methods have proved valuable also in prospecting for iron ores, such as magnetite and specular iron. Although magnetite may be discovered by means of magnetic methods, the information gained from a magnetic survey is rather limited. By means of an electrical survey, however, it is possible to direct the electrical field suitably and thus study various disturbances caused by the orebody, and obtain information as to the nature of the orebody." Lundberg gives the approximate field costs of a reconnaissance survey by electrical methods as $2,000 to $2,500 per square mile.

Successful search at the Britannia mine, in British Columbia, for orebodies by the Swedish methods was described by J. I. Moore and F. Ebbutt.[4] Here the conditions were especially favorable for the application of the equipotential method.

Dr. C. A. Heiland[5] gives one of the best summaries of methods, apparatus, and principles involved in geophysical research. He states that geophysical surveying methods are as yet only at the beginning of their development, but that the results so far obtained encourage the hope that when carried to greater perfection and used to supplement each other they will eventually constitute a more and more indispensable part of the equipment of the mining engineer and of the geologist. This conclusion brings out the changeable status of the whole subject at present.

Application of magnetic surveying methods to placer ground was described by K. C. Laylander[6] and apparently under certain conditions, such as black-sand concentration, significant results can be obtained. Further work in this field appears to be necessary to establish the importance of the method.

Underground deep-hole prospecting is being applied in a number of instances and has proved efficacious under suitable conditions for testing areas contiguous to ore zones. Eagle-Picher mines are using a deep-hole drill to pick up narrow "runs" of ore which are often missed by churn-drill holes drilled from the surface. W. F. Netzeband in a late Institute paper gives cost of deep-hole drilling in the mines of the Eagle-Picher Lead Co. as $2.12 per foot.

Drift of diamond-drill holes has always interested the metal miner, and different instruments have been devised to survey approximately the course of a bore hole. A parallel situation is found in petroleum mining. The drilling of deep wells, 5,000 to 7,000 ft. in depth, has caused a need for oil-well surveying instruments. F. M. Smith[7] describes conditions under which surveying

[1] *Mining Congress Journal*, Sept., 1926.
[2] *Op. cit.*, Oct., 1926.
[3] *Op. cit.*, Oct., 1926.
[4] *Trans.*, Can. I.M.&M., Vol. 29, 1926.
[5] *Engineering and Mining Journal*, Vol. 121, p. 47.
[6] *Op. cit.*, Vol. 121, p. 325.
[7] *Op. cit.*, Vol. 121, p. 241.

instruments devised by Alexander Anderson were used to determine deflection and drift in certain wells. Unfortunately, a description of Anderson's instrument was not given. However, the dependence of the petroleum engineer upon adequate bore-hole surveying methods was definitely established.

A description of methods used in prospecting diamond-bearing areas in the Gold Coast Colony was given by A. Livingstone Oke[8], who states that diamonds, in common with other alluvial concentrations, run in leads, so cross-pitting must be close in order to be conclusive. A standard-size pit, 4½ ft. long by 2 ft. in width, is in use. As soon as gravel is reached, the pit is squared off and cleaned up to the top of the gravel before the latter is removed. Rockers and jigs are used in washing gravel. Final cleaning of the "concentrate" is effected on a small, round, hand screen. The diamonds from each pit are weighed, the yardage being figured upon the thickness of the gravel, as the pits are one square yard in area.

Open-Pit Mining Develops Novelties

At the Utah Copper open-pit mine, the Diesel-electric locomotive has proved to be a decided success on level hauls. Haulage costs have been reduced by one-half. A 75-ton trolley storage locomotive has been ordered for yard service. The all electrically equipped open-pit operation is apparently in sight, and for larger tonnages from compact workings there is little doubt that electrically operated equipment is much more economical than that operated by steam.

Two interesting papers were published on open-pit operations at the United Verde mine[9]. This pit is interesting chiefly for the hard-rock overburden, a blocky diorite. Churn drilling in soft diorite gave 10 to 15 ft. of hole per shift and in fresh diorite and jasper only 3 to 5 ft. per shift. C. E. Mills gives useful quantitative data and logical reasons for the resort to "coyote blasting." E. M. J. Alenius describes such a blast as applied to a bank 155 ft. in height. The estimated quantity of 105,000 cu.yd. broken gives a ratio of 1.016 cu.yd. per pound of explosive. Four days was required to load the system of chambers. A large amount of 50 per cent gelatin dynamite was used in the primer charges. Cordeau and electric blasting caps were used in detonating the charges.

H. M. Ziesmer[10] describes sampling and estimating practice at the open pit on Sacramento Hill, Bisbee, Ariz. Underground workings first proved the existence of the orebody, but a total of 46,190 ft. of churn-drill holes was drilled within the limits of the west orebody to obtain complete data. Holes were put down on the corners of 100-ft. squares and averaged 515 ft. in depth. The sample interval was 5 ft. Distribution of different grades of ore was diagramed from churn hole results. The practice of sampling each trainload and the rapid determination of its copper content is novel. Disposition of ore, to either mill or leaching dumps, is determined by the results of the sampling. Selection or ore grading is worked out in various ways in open-pit copper mining, but seldom are sampling and assaying carried out to the extent described by Ziesmer.

At Neihart, the Silver Dyke Mining Co. has developed an unusual open-pit practice. The pit is opened out from 5x5-ft. raises which are enlarged to 15 ft. in diameter by retreating upward. Deep churn-drill holes enlarge the excavation by slabbing the holes to the full height of the pit. Churn-drill holes are 200 to 265 ft. in depth and are charged to a length of 120 ft. from the bottom, the powder charges alternating with plugs of stemming. Cordeau Bickford fuse is used for detonating the charge. Successive rows of holes about the periphery of the pit break to its full depth and maintain practically vertical walls. The brecciated and altered nature of the ore mass facilitates churn drilling and breaking.

Study of Working Specifications in Underground Mining

A more particular attention to physical nature of rock and ore masses encountered in mining is advocated by G. Townsend Harley[11], as a basis for more logically applying methods. This recognition of the interdependence of physical characteristics of rocks and methods has long been needed. It is true that the nomenclature is deficient and classifications are hard to define, but practice will evolve sufficiently accurate measures to meet the needs of the situation. The general adoption of bonus and contract systems has given impetus to working out adequate rock classification schemes. The work of the Phelps Dodge Corporation in the Bisbee district has been especially helpful. Butte district has adopted, with modifications, features of the Arizona practice. The drift toward miners' compensation based on performance is very general and the need for specifically measuring performance will automatically give importance to the kind of studies advanced by Harley.

A brief sketch of mining methods in the Butte district is given by H. J. Rahilly[12]. Rill, stull, and square-set stopes are generally employed as conditions determine. Almost all of the mines use a standard square set, 5 ft. 4 in. center to center, and a 7-ft. 5-in. post. A stope is filled to within two floors of the back, the uppermost being the miners' floor and the one below it the muckers' floor. The methods have been previously described.

Mining methods in the Grass Valley district[13] are described by J. A. Fulton and A. B. Foote. The flat narrow vein of the North Star is mined in 60-ft. advances parallel with the strike and successively up the dip, scrapers being used to move the broken ore to the loading tracks, where plank platforms are erected to such a height as to enable the scraper to deliver to cars.

A review of copper mining methods in Arizona[14] describes the practice at the larger mines. R. W. Thomas[15] describes in detail mining methods at Ray, Ariz. G. Townsend Harley[16] describes a modification of inclined top-slicing which involves the use of the scraper for horizontal ore movement. C. E. Wethered[17] briefly describes drifting and stoping at the Morning mine, Mullan, Idaho. A novel method of "retreating-bench stoping" is proposed by F. T. Rubidge[18]. In this method a chamber of suitable width, 40 to 60 ft., is opened out by a raise which is widened to the full width

[8] Bull. 255, I.M.&M., p. 1.
[9] *Engineering and Mining Journal*, Vol. 121, p. 928; Vol. 122, p. 44.
[10] *Mining Congress Journal*, Sept., 1926.
[11] *Engineering and Mining Journal*, Vol. 122, p. 368.
[12] *Mining Congress Journal*, August, 1926.
[13] *Trans.*, A.I.M.E., Feb., 1926.
[14] *Engineering and Mining Journal*, Vol. 121, p. 437.
[15] *Mining Congress Journal*, May, 1926.
[16] *Engineering and Mining Journal*, Vol. 121, p. 158.
[17] *Explosives Engineer*, August, 1926.
[18] *Op. cit.*, Vol. 122, p. 255.

of the chamber and to the full height. The sill drift is also widened out to the full width of the chamber and to a height of about 15 ft. A timbered drift is constructed on the floor of the chamber at the center to provide for handling cars. A top drift gives access to the top of the chamber. Rock is broken down by underhand stoping in a series of benches. Loading is by mechanical loader. The timbered drift is extended as the working face is drawn back. Part of the broken rock is left on the floor of the chamber and is cleaned out when the chamber is completed. The method suggested is of use in mining limestone and is offered as a substitute for open-pit work. About a year ago I was told of a similar method of underground "quarrying" in use in a California limestone quarry. The timbered drift was omitted and loading was by hand methods.

The collapse of top formations over mine workings at the Barnes-Hecker iron mine in the Ishpeming district of Michigan which occurred on Nov. 3, 1926, and was attended with a loss of 51 lives, again calls attention to the need for a more thorough consideration of the major physical features characterizing a mining operation. This devolves upon management. Minor and fire hazards have received close attention, but the more obscure hazards often do not receive the attention they deserve.

Shaft Sinking by Novel Methods

Shaft sinking under difficult conditions of an interesting nature is described by J. B. Stewart[19]. Stewart assumed charge of the work at Suria, Spain, after a 19.5-ft. shaft of circular section had been sunk to a depth of 325 ft. The first 130 ft. was sunk by ordinary methods and lined with brick to a thickness of 30 in. The next 195 ft. was sunk by cementation process in six stages, averaging 33 ft. each. The time required was two years. Cementation had been effected through diamond-drill holes angled out from the shaft bottom, which was sealed with a 3-ft. slab of concrete after each sinking and lining stage.

The extension of the Pilares shaft of the Moctezuma Copper Co. from the 1,400 to the 1,800 level by pilot raises followed by shrinkage stopes over the section of the shaft is described by E. Leland[20]. The method avoids some of the objections encountered in straight raise construction. Three major steps are involved: first, the driving of pilot raises; second, the enlargement of the pilot raise to full shaft section as a shrinkage stope entered from the raise; and, third, the timbering of each section from the top downward as the residual broken rock is drawn off. Bulkheads were used to isolate the respective sections during the timbering work while service was maintained in the upper portion of the shaft.

Details of sinking 608.3 ft. of a three-compartment shaft at Victor, Colo., are given by A. F. Carper[21]. The cost of this shaft was $38.75 per foot, based partly on contract and partly on company time. This approximates 38.2c. per cubic foot of shaft on over-all timber dimensions (16x6.3 ft.) and 27c. per cubic foot on gross dimensions (18x8 ft.). Oregon fir timber was used, the sets being placed at 6-ft. centers. Timber requirement was 0.166 cu.ft. of timber (2 bd.ft.) per cubic foot of shaft on over-all timber dimensions. Framing cost was about $1 per 100 bd.ft. Timbers were 10x10 in. in section.

The Institute's subcommittee on coal mining[22] reports to the committee on ground movement and subsidence that collection of available data with reference to subsidence in bituminous mines has been about completed, and in its report a large amount of data is given. The work of these committees is highly commendable and should result in important conclusions when completed.

C. A. Robatham[23] gives details of pneumatic placement of concrete at Ray, where this material is used for the support of permanent haulageways. Robatham states that the success of pneumatic placement depends upon the availability of sufficient compressed air without crippling more important operations. He states that concrete can be conveyed 2,500 ft., but beyond this distance the air consumption is excessive. An average of 30 ft. of 7x8-ft. drift was concreted at Ray per day of two shifts. On heavy pillar and beam work in stations as much as 130 cu.yd. has been conveyed 1,000 ft. and placed in approximately twelve hours. Late costs were about $22 per cubic yard of concrete. Robatham gives cross-sections showing designs used for the support of 7- and 15-ft. haulageways supported by reinforced concrete.

Importance of a suitable supply of mine timbers derived by reforestation and tree planting is brought out by Harry E. Tuft[24] in the case of the Rand mines. He states that the bulk of the witwatersrand timber supplies is drawn from the Wattle plantations in Natal. Except for pitch pine, Douglas fir, and Baltic pine timbers, practically no timber was imported by the mines from outside South Africa. Pillar supports of the hanging wall has been discarded in favor of rock-filled timber cribs or "pigsties," the lagging poles for this purpose being 4 to 5 in. in diameter at the small end and 8 ft. in length. They are rigged in the form of a square and filled with waste rock. In place of notching the intersections, poles are bored and timbers are fixed in position by iron pegs $\frac{1}{2}$ to $\frac{5}{8}$ in. in diameter and 3 in. in length. This method, which saves about 10 per cent of the vertical height of the timber crib, was devised by H. W. Adler. Experiments have also been made with concrete "packs." Each pack is cushioned at the top with timbers. The cost of the concrete packs is greater than timber work, but they are more permanent. Experiments are being made in building concrete pillars *in situ*, and in other places waste rock packs held by wire netting stretched around four posts are being tried. Tuft notes the increasing use of timber preservatives and states that promising results have been obtained with zinc sulphate.

The problem of roof support is an important one, especially where extensive areas are opened out in orebodies of low dip. Mining engineers on the Rand have through necessity given much attention to a practical solution of the problem. Two interesting papers[25] on the subject appeared during the year and are well worth detailed study.

Fireproofing of mine timbers by an outer coating of gunite applied over wire netting was adopted in the Butte district some years ago. Although effective from

[19] *Mining & Metallurgy*, Vol. 7, p. 376.
[20] *Engineering and Mining Journal*, Vol. 122, p. 569.
[21] *Op. cit.*, Vol. 122, p. 657.
[22] *Trans.*, A.I.M.E., Feb., 1926.
[23] *Mining Congress Journal*, May, 1926.
[24] *Engineering and Mining Journal*, Vol. 121, p. 650.
[25] J.C.M.&M., Soc. of S.A., July, 1926: "Support of Workings on the Van Ryn Deep," by A. E. Payne; "Method of Supporting Hanging on the New State Areas, Ltd.," by James Richardson.

the fireproofing standpoint, it is of interest to note that underground timber structures thus inclosed are subject to dry rot, and it is now the opinion that timber preservatives are necessary as a preliminary treatment where timbers are to be gunited.

VENTILATION AND MINE DRAINAGE

Permissible limits of toxic and noxious gases in mine and tunnel ventilation are discussed by Dr. R. R. Sayers[26]. Carbon dioxide and oxygen sufficiency are considered generally as well as methane, sulphur dioxide, nitrogen oxides, hydrogen sulphides, and carbon monoxide. Doctor Sayers does not attempt to place percentage limits of these gases but does give interesting comment on their effects upon humans. E. D. Gardner, G. W. Jones, and J. D. Sullivan[27] report the results of investigating gases derived from blasting in heavy sulphides and show that large amounts of sulphur dioxide may be generated as well as some of the more noxious hydrogen sulphide. The presence of water appears to favor the formation of the latter gas. Adequate ventilation is suggested as essential for mining operations in heavy sulphide orebodies. Rock and air temperatures in deep level mines on the Rand[28] are discussed by M. O. Tillard and E. C. Ransome. The paper gives the results of kata-thermometer investigations and control of working temperatures by air currents. Gas masks and respirators for metal-mine service are described by J. T. Ryan[29]. A discussion of theory of mine ventilation is presented by A. C. Callen[30]; mine air flow by G. E. McElroy[31]; operating characteristics of centrifugal fans by Louis W. Huber[30], and the application of Kutter's formula to gas by F. Ernest Brackett[31].

Treatment of acid- and copper-bearing waters as a preliminary to pumping is discussed by H. L. Lavender,[32] who describes practice in the Bisbee district. Neutralization by lime was superseded by air agitation and precipitation on iron scrap. This was effected in water-proofed concrete boxes. High extraction of the copper and almost complete neutralization was effected. Lavender also calls attention to underground leaching of a fire zone in the Briggs mine. A. H. Hubbell[33] discusses automatic control of centrifugal pumps, which practice is now accepted as a feature of recent installations. Ball bearings are being used to an increasing extent on mine pumps and on electric motors as shown by W. F. Boericke.[34]

UNDERGROUND LOADING—ROCK DRILLS AND DRILLING

Experiments with loading equipment at the United Verde mine are presented by W. V. De Camp[35]. An electrically operated power shovel, ⅝-cu.yd. dipper, was tried out as well as experiments with scraper rigs. De Camp states that in horizontal cut-and-fill stopes there is no economy over hand work under present conditions and that for spreading waste rock the margin gained by the use of scrapers is not sufficient to justify installation of the necessary equipment. Lucien Eaton,[36] in reference to the use of scrapers in iron-ore mining, states that the increase in the number of scrapers used to move ore directly into the chute during the last two years has been remarkable, especially in the case of mines using top-slicing methods.

In the Butte district automatically rotated stopers are being used to a considerable extent, one large company increasing its equipment of this type of stoper. Replaceable drill bits continue to be used at several of the Butte mines, but have not spread generally to other districts. Apparently the replaceable drill bit has a definite narrow application within which it will slowly spread to other mines. Drill-sharpening practice at Franklin, N. J., is described by C. M. Haight.[37] Heat-treating machines are used and attained a maximum output of 112 drills per hour and a minimum of 56. Haight states that the uniform and correct results obtained from the use of this machine should considerably reduce the amount of steel to be sharpened and should also reduce the transportation costs for drill steels. I. M. Marshall[38] brings out the importance of properly selecting lubricants for rock-drill operation and the need for a lubricating device that will insure a continuous flow of lubricant to the cylinder. Drilling and blasting practice at the United Verde mine is given in detail by C. E. Mills.[39] A ground classification based on drilling speed is presented and increased drilling rates, obtained by reducing the diameter of starting bits, are shown to range from 27 to 43 per cent. Layouts for various rounds are illustrated.

Two papers on liquid-oxygen explosives indicate the interest taken in this subject. G. St. J. Perrott[40] reviews the subject generally, and Frederick W. O'Neil and Herman Van Fleet[41] give the results of experimental researches made by the Ingersoll-Rand Co. and the Air Reduction Co. from early in 1922 to date. The account is thorough and stresses the suitability of L.O.X. for quarry and open-pit mining. A symposium dealing with accidents from explosives on the Witwatersrand mines by Sir R. N. Kotze[42] draws attention to the need for greater care in looking for misfires and unexploded explosives and particularly the subject of misfires. An unusual magazine explosion is described by W. V. De Camp[43] and indicates the necessity of careful design of magazine accessories, particularly for thawing purposes.

Hoisting practice, which now appears usually in articles describing specific installations, is represented by a general article from A. B. Calhoun,[44] wherein he discusses shafts, hoisting arrangements, headframes, hoisting machinery, ropes, and operating details. C. C. Greenwood[45] states that the Cananea Consolidated Copper Co. will probably produce in 1926 some 3,000,000 lb. of copper from underground leaching of ore in place. Details of the practice and experimental work at this mine are given. Charles A. Mitke[46] attacks the problem of reducing mining costs in the Southwest and analyzes the important factors that show opportunity of improvement.

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[26] *Trans.*, A.I.M.E., Feb., 1926.
[27] U. S. Bureau of Mines, Serial 2739.
[28] J.C.M.&M., Soc. of S.A., Feb., 1926.
[29] *Mining & Metallurgy*, Vol. 7, p. 384.
[30] *Trans.*, A.I.M.E., Feb., 1926.
[31] *Trans.*, A.I.M.E., Oct., 1926.
[32] *Mining Congress Journal*, Sept., 1926.
[33] *Engineering and Mining Journal*, Vol. 121, p. 997.
[34] *Mining & Metallurgy*, Vol. 7, p. 424.
[35] *Mining Congress Journal*, March, 1926.
[36] *Op. cit.*, March, 1926.
[37] *Trans.*, A.I.M.E., Feb. 1926.
[38] *Engineering and Mining Journal*, Vol. 122, p. 13.
[39] *Op. cit.*, Vol. 121, p. 877.
[40] *Op. cit.*, Vol. 121, p. 357.
[41] *Trans., A.I.M.E.*, Feb., 1926.
[42] J.C.M.&M., Soc. S.A., August, 1926.
[43] *Engineering and Mining Journal*, Vol. 121, p. 404.
[44] *Op. cit.*, Vol. 122, p. 485, 524.
[45] *Op. cit.*, Vol. 122, p. 518.
[46] *Op. cit.*, Vol. 121, p. 681.

FLOTATION *Dominates Ore-Dressing Progress*

New Crushers—Hindered Settling Classifiers Developed—Improved Machines

By Charles E. Locke

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Charles E. Locke

AGAIN flotation holds the stage as having made the most marked progress in 1926. However, all ore dressing has expanded and improved in technique. This expansion resulted in part from the general prosperity of the mineral industry during the year, but also from the change, now going on in the whole mining industry, toward the exploitation of lower-grade deposits on a large scale with the passing of the rich direct-shipping ores and the decrease in the number of small mines. These lower-grade deposits can be worked economically only with the aid of concentration. As specific example of this tendency there is the rapid growth of milling in Mexico during the last two or three years. Even in the Lake Superior iron-ore regions the necessity of more and more beneficiation is causing a thorough study of the whole problem by the states of Minnesota and Michigan. If it were not for concentration the prices of some metals would be soaring to high figures.

Crushing operations continue to be fairly well standardized. The first of two large 60-in. gyratory crushers for the Chile Copper Co. has been completed. Its weight is approximately one million pounds, and it will receive lumps up to 5 ft. in size and crush to a 12-in. product at the rate of 2,000 to 2,500 tons per hour. The new Symons cone crusher is being tried out on lead ore in Southeast Missouri, with promising results. This machine is a cross between a gyratory and a Symons vertical-shaft disk crusher in that it has the eccentric drive of the gyratory, but the head slopes only 45 deg. and is carried in a large concave bearing support. Feed is 3 to 3½ in. in size and the product is around ¼ in.

In the general practice of fine grinding by rod mills, ball mills, and pebble mills, the closed-circuit method is commonly accepted as being more efficient than open circuit. Concrete evidence by H. W. Shoemaker[1] of the actual saving in the Lake Shore mill at Kirkland Lake shows ball consumption reduced from 5.9 to 3.4 lb. per ton and power from 305 to 290 hp., or actual cost from 36.3c. to 21.7c. per ton. Formerly 1-in. feed went to 7x6-ft. open-circuit ball mill, discharging to Dorr bowl classifier in closed circuit with 5x16-ft. tube mill using small steel balls. Now the coarse mill also operates in closed circuit with a Dorr duplex classifier, which delivers overflow to the Dorr bowl classifier. The above figures cover the two mills and the classifiers but do not include the saving in mill linings, which will probably amount to 6c. additional per ton.

[1]*Engineering and Mining Journal*, Vol. 121, p. 367.

For grinding media in ball mills, spheres are most common, although cubes and irregular slugs are used somewhat. Based on the work at Nacozari with cubes, E. H. Rose[2] has made a theoretical study of the action of cubes, rods and spheres which shows the advantage of cubes in avoiding slimes.

A step toward higher efficiency in crushing is the new development in South Africa gold mills where the very hard, coarse, rounded fragments are removed from the finer part of the circuit returning to the tube mills, and are cracked down in another crushing machine before they are re-fed into the tube mill.

As yet two-stage grinding in a single mill having two compartments seems to have found little favor on ores, in spite of the fact that the Allis-Chalmers Compeb mill of this type has been so successful for wet grinding in the cement industry. The Williamson mill, which has only just come out, and which is being tested at the Inspiration mill with promising results, has a series of step-like or wedge-shaped extensions in place of the usual end liners, these projections at the discharge end being perforated. Their effect is to give more thorough mixing of the charge with quicker discharge, greater capacity, reduced power and increased efficiency.

On the theory of crushing, investigation by the U. S. Bureau of Mines at Salt Lake City has developed new methods for accurate measurement and calculation of the total surface of a mass of ore particles, and this work further substantiates the Rittinger theory of crushing. To avoid actual measurements of surface for comparing crushed products and computing relative grinding efficiencies, E. H. Rose[3] proposes the use of the "grinding index" which is actually a weighted average screen analysis. To A. M. Gaudin[4] belongs the credit for investigating crushing phenomena from another viewpoint. He has shown that homogeneous rocks and heterogeneous rocks follow different laws which govern the character of the products obtained by various methods of crushing. Incidentally, his results further support the Rittinger theory.

The popularity of vibrating screens is leading to the appearance of new makes on the market, such as that of the Link Belt Co., which uses the unbalanced pulley principle and has ball bearings, and the Vibrex screen of the Robins Conveying Belt Co., which likewise has an unbalanced pulley. The Screen Supreme now being distributed by the Traylor Vibrator Co., of Denver, vibrates the entire screen frame by means of reciprocating electric motors which impart 3,600 vibrations per minute.

Recognition of need of better classifiers in preparing the feed for tables to produce better table work, and in closed-circuit grinding to increase the efficiency of the grinding, has led to two important events. The Dorr Co. has taken over the manufacture of the Fahrenwald constant-density classifier as representing the most

[2]*Op. Cit.*, Vol. 122, p. 95.
[3]*Op. cit.*, Vol. 122, p. 331.
[4]A.I.M.E., Preprint No. 1565, Feb., 1926.

efficient form of hydraulic classifier yet developed, and the South African gold mills have found that Dorr classifiers show marked improvement over cones when used in closed circuit with pebble mills. Taking the efficiency of cones as 100, the Dorr classifier with rake alone stands at 117 and the Dorr bowl type is at 125. It is understood that the U. S. Bureau of Mines, after having successfully developed the constant-density classifier, is now working on a fine-sand and slime classifier employing a reciprocating pulp tank to give agitation in the pebble bed.

To the Gentner and Oliver-Borden machines, which combine filtering with thickening, is now added the new Sweetland thickener of the United Filters Corporation, which in fundamental principle resembles the Gentner. Successful work of the Hydrotator on thickening blast-furnace flue dust is reported.

Previous knowledge of the laws governing the settling of particles in classifiers under free and hindered settling conditions has been broadened by the studies of the U. S. Bureau of Mines on the stratification of ore particles over a wide range of water velocities in jig beds, table riffles, and classifiers.[5]

Nothing of importance is to be noted in the design of jigs and tables. Improvement continues in jig operations on Joplin zinc ores and Illinois fluorspar ores as a result of the thorough study of jig action by the U. S. Bureau of Mines staff. By a new system of combining the three operations of tabling, intensive classification, and jigging, a satisfactory fluorspar concentrate can be obtained as fine as 100 mesh. Improved jigging in Joplin zinc mills, together with the addition of flotation, has raised the mill extraction.

New experimental evidence on the relative advantages of natural, screened, and classified feeds for Wilfley tables indicates that there is no marked difference in results from the three forms of feed, but such differences as exist are perceptibly in favor of classified feed.[6]

It is impossible to do more than touch the high spots in recording recent flotation progress. This process is proving a valuable aid in more efficient treatment of gold ores in South Africa, Rhodesia, and Australia, where the gold is refractory, occurring with sulphides of iron, often associated with arsenic and antimony. The experimental work on the gold ores of the Rand indicates that flotation may serve as an adjunct to cyaniding to increase the gold saving.[7] Similarly, the testing of Kalgoorlie gold ores by flotation followed by roasting and cyaniding of the concentrates predicates a more efficient and economical process.

Novel uses of froth flotation are: at Radenthein, where talcky and clayey material is floated away from a nesite; at Trail, where fluorite is floated away from a siliceous gangue; and at Birmingham, where the U. S. Bureau of Mines has experimentally floated limestone away from silica in blast-furnace flue dust by the use of oleic acid and creosol together at the rate of 1.5 lb. per ton. Hope exists that ultimately iron oxides may be floated.

Selective and differential flotation has made the greatest advance, and from an economic viewpoint the continued development of custom flotation mills for zinc-lead-iron ores is the outstanding feature of the year. In practically all ores having lead associated with zinc or with zinc and iron, differential flotation is now the common practice. It means greater prosperity to every one in lead-zinc districts, more freight for the railroads, more ore and easier ore to be smelted, and greater profit to all concerned. An incomplete enumeration of the custom plants includes the Timber Butte mill, the old Trail mill remodeled, some Coeur d'Alene plants, the Tooele plant and the Rico plant (started in November) of the International Smelting Co., the new Midvale plant of the U. S. Smelting, Refining & Mining Co., the Bauer plant of Combined Metals Co., and the proposed Bisbee mill of the Phelps Dodge Corporation.

Flotation Plant Improvements

The Midvale plant is being enlarged from 650 to 800 tons, daily capacity, and the Tooele plant treats 1,000 tons. These two plants together produce 13,000 tons of zinc concentrates monthly, besides the lead. The Bauer plant treats 180 to 200 tons daily, making zinc concentrates with 51.5 per cent zinc and 2 per cent lead and lead concentrates with 40 per cent lead and 4 per cent zinc. The remarkable result is in Utah alone an estimated zinc production of 125,000,000 lb. in 1926, against 52,611,732 lb. in 1925, 18,572,172 lb. in 1924, and 6,474,615 lb. in 1906.

The Utah Apex mill, at Bingham, has been changed to differential flotation. A striking example of the advantage of this process over older methods on an ore containing about 9.6 per cent lead and 7.2 per cent zinc has been reported by J. M. Callow[8] and is summarized in the accompanying table. Method (1) was table concentration, saving lead only; (2) was flotation for lead only; (3) was differential flotation of lead and zinc; and (4) was the same with heating of the zinc circuit. Method (4) gives $5 more profit per ton than (1).

Method	Recovery Per Cent		Assay of Lead Concentrates, Per Cent		Assay of Zinc Concentrates, Per Cent	
	Lead	Zinc	Lead	Zinc	Lead	Zinc
1	94	..	18	6.0	...	..
2	91	..	53	...	...	..
3	95	74	52	4.9	0.5	49
4	94	88	51	5.7	1.5	52

One section of the new Utah Apex mill handles lead-copper-iron sulphides. The lead and copper are first floated together by the use of xanthate, thus eliminating the iron with the tailings. The lead-copper froth is next conditioned with 1 lb. lime and 0.5 lb. sodium sulphide per ton, thus deadening the copper and enabling the lead to be floated from it in the final separation step.

In the Tri-State zinc district flotation was neglected until two or three years ago, when it began to come in with a rush to handle current slimes and old tailings dumps, with the result that the district may be said to be heading toward 100 per cent flotation. From a feed with 0 to 2 per cent lead and 5 to 30 per cent blende, the lead concentrates carry up to 70 per cent lead, the zinc concentrates 54 to 57 per cent blende and under 1.5 per cent lead, and tailings under 0.1 per cent lead and 1.25 per cent blende. Technique has been described by C. O. Anderson.[9]

Universal interest in differential flotation has led to the appearance of a number of valuable papers which for lack of space can only be referred to here as follows: The Bauer plant by E. H. Robie[10]; the Tooele plant, with the technique and economics of custom flotation, by W. C. Page[11]; the Parral lead-zinc mill in Mexico, by A.

[5] A. W. Fahrenwald: *Mining & Metallurgy*, Vol. 7, p. 437.
[6] E. W. Wells: *Op. cit.*, Vol. 7, p. 156.
[7] H. H. Smith: *Engineering and Mining Journal*, Vol. 122, pp. 175, 215.
[8] *Op. cit.*, Vol. 121, p. 542.
[9] Paper read before the American Zinc Institute, April 19, 1926.
[10] *Engineering and Mining Journal*, Vol. 121, p. 405.
[11] *Mining & Metallurgy*, Vol. 7, p. 254.

B. Parsons[12]; the new Midvale mill, by J. F. Geary[13]; the Sunnyside lead-zinc mill by E. H. Robie[14]; and the Cananea plant, floating copper sulphides from pyrite, by A. T. Tye.[15]

Flotation is not the complicated process that it was some years ago. Best success in differential flotation, and in fact in all flotation, lies not so much in choice of machines and reagents as in careful control of conditions, including: (1) amount of reagents, (2) conditioning and even temperature, (3) alkalinity or acidity, (4) pulp density. It may even be necessary to treat the water, as at Cananea, where acid mine water has to be neutralized with lime and the precipitated iron salts removed before the water is suitable for use in flotation. The detailed report by T. Varley[16] of reagents used in 1925 shows that over 45,000,000 tons of ore was treated by flotation in the United States during 1925, that chemicals are replacing oils as flotation reagents, that the amount of reagents per ton of ore is decreasing, and that alkaline circuits have largely replaced acid circuits.

The introduction of lime circuits has led to clogging and short life of the porous mats in pneumatic cells, with higher power consumption and increased cost. The MacIntosh machine, developed at Nacozari, overcomes this trouble by replacing the fixed air mat with a canvas-covered horizontal cylinder slowly rotating in the bottom of the cell. Air enters the cylinder through a hollow shaft and then passes outward into the pulp through the canvas covering. This machine has been taken over by the General Engineering Co. Another solution of this same problem is the Forrester machine, used at Globe, Ariz., and elsewhere, which goes a step further and ingeniously distributes the air through the pulp without the use of any porous medium whatever.

Even on the baffling subject of flotation theory much is being learned of the effects of cyanide and alkali on the flotation of various sulphides. In the case of pyrite these salts inhibit flotation by the formation of a coating of adhering particles on the pyrite, and microchemical tests of these particles show the presence of ferric iron.[17] The minute investigation of these surface coatings in flotation is being continued by the U. S. Bureau of Mines, with some rather interesting results. There is even some evidence that the flotation of minerals is in some way connected with their property of consuming oxygen.

Unfortunately, flotation litigation still continues. The decision in the Magma case has not been handed down, although more than three years have elapsed since the filing of briefs. New litigation consists of the suit of Metals Recovery Co. against the Anaconda company in the federal court for infringement of the basic non-oleaginous flotation-agent patent No. 1,364,304. This has not yet come to trial.

Along the line of general milling equipment use of rubber is gaining where resistance to wear is desired. An innovation is rubber-lined pipe to carry sandy pulps.

The value of the microscope in ore dressing has always been recognized, but its use is now almost essential in dealing with the complex finely disseminated ores which can be separated only by flotation, and in studying the effects of flotation reagents on various minerals. Professor Taggart's long-promised "Hand Book of Ore Dressing" is finally going through the press of John Wiley & Sons, and should make its appearance early in 1927.

[12] *Engineering and Mining Journal*, Vol. 122, p. 644.
[13] *Op. cit.*, Vol. 121, p. 917.
[14] *Op. cit.*, Vol. 121, p. 757.
[15] *Op. cit.*, Vol. 121, p. 597.
[16] U. S. Bureau of Mines, Report of Investigations No. 2777.
[17] E. L. Tucker, J. F. Gates, and R. E. Head: *Mining & Metallurgy*, Vol. 7, p. 126.

HYDROMETALLURGY *Becoming Standardized*

Advances in Copper and Zinc Leaching—Status of Processes

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A COMPLETE review of hydrometallurgy properly includes consideration of wet methods, either in operation or being tested, for copper, zinc, or lead ores, together with those carrying gold and silver, either alone or in combination. The status of these various methods, however, from the viewpoint of this article is very different, and what is newer demands space in preference to older and well-known methods. Cyaniding practice has been upon a standardized basis for years. Both copper and zinc leaching are now more or less in a similar position—that is to say, the metallurgy has been sufficiently worked out and enough engineering design and data covering the results of the operation of existing plants are available to make solution of problems in these two lines a matter of practical certainty. As a result important new zinc and copper plants are being erected or considered. Lead leaching has promising possibilities, but cannot be said to have attained so favorable a position as yet, and there is distinct opportunity for the metallurgist in this field. Since commercial conditions for some problems demand finished products, and also because the best present selective-flotation practice produces zinc concentrates carrying appreciable amounts of lead and lead concentrates carrying appreciable amounts of zinc, there is still opportunity for wet methods for complex ores, either as a substitute for or as an adjunct to selective flotation.

G. D. Van Arsdale

Mechanically, it is interesting to compare copper-leaching operations with those of cyaniding. The mechanical problems are essentially the same; that is to say, the dissolving of metals from inert gangue and the subsequent removal of their solutions for extraction

of the dissolved metals. Percolation is simple in operation and installation, but it was soon recognized in cyanide practice that a charge crushed sufficiently to give the best access of solution to mineral resulted in the production of fines, together with an uncontrollable amount of primary slimes, depending on the ore character, such as to prevent efficient percolation and washing. Obviously the solution of this difficulty was separate sand and slime treatment, and from this the next step to all fine grinding was easy.

Most copper leaching is done by percolation, and precisely the same crushing problems arise. Therefore a compromise must be made between the degree of grinding known to be best from the extraction standpoint, as against a grinding that will permit of good percolation. It seems reasonable to predict, therefore, that copper leaching, like cyaniding, will be forced to accept separate treatment of sands and slimes and may eventually come to all fine grinding.

During 1926 an important advance in copper hydrometallurgy was the completion of the $6,000,000 leaching plant of the Inspiration Consolidated Copper Co. This is the first large plant to use direct leaching, without roasting, for copper present as sulphide. The copper in this ore is a mixture of oxides, mainly silicate, and chalcocite. The leach liquor to be used is an acidified solution of copper and iron sulphates, the ferric form of the latter being the solvent for the chalcocite, while the free acid dissolves the copper present as silicate or in other oxidized forms. Ferric iron is regenerated during electrolysis. Reduced current efficiency due to the ferric iron present during electrolysis will be partly compensated for by carrying a higher current density than at Ajo. The copper sulphide in the ore takes the place of the sulphur dioxide used at Ajo for ferric iron reduction; otherwise the methods and the two plants are quite similar in principle and operation. Methods are available for controlling the ferric-iron balance necessary to meet variations in the relative proportions of oxides and sulphides in the ore.

A leaching cycle of about thirteen days will be used, made up of one day each for filling and emptying vats, about eight days, actual leaching time, and about three days for washing. Provision has been made for a so-called circulating wash, which is expected to make a nearly complete extraction of the dissolved copper. A description of the experimental work leading to the adoption of the method has been published,[1] and an account of the plant and its operation will no doubt appear later.

The first ore charge was placed in the vats on Oct. 3, 1926. To build up leaching solutions in copper and iron, the ore during the preliminary period will be held as closely as possible to a maximum of oxide and a minimum of sulphide content, the reason for the latter condition being that ferric iron, the solvent for chalcocite, is made in the tank room and obviously must reach the desired minimum percentage in the solutions before efficient sulphide leaching can be accomplished. Tankhouse operation was started on Nov. 10, 1926. For the small amount of cement copper that will be made, redissolved, and finally turned out as cathodes, the plant will use detinned and baled tin cans, a satisfactory precipitant.

[1] *Trans.* A.I.M.E., 1926.

The Bwana M'Kubwa, whose reserves are stated to be between seven and eight million tons of about 4 per cent ore, is an important new development in Africa. Its treatment plant is expected to start with a capacity of about one thousand tons per day, increasing to two thousand and later to three thousand tons, if developments warrant. The treatment method was developed by engineers of the Minerals Separation Co., but does not involve flotation. The copper apparently occurs largely as silicates, which are "broken down" at a dull red heat, producer gas being then brought in contact with the heated ore to effect a partial reduction to metal. After this treatment, the ore is subjected to the leaching action of a solution of ammonium carbonate and the copper precipitated as oxide therefrom by driving off the ammonia through the application of heat to the solutions. It is stated that Bwana M'Kubwa expects to be able to deliver copper in London for about 10c. per pound. An editorial in the *Engineering and Mining Journal* states that this enterprise, next to Granby, will be the most important copper producer in the British Empire, and next to Rio Tinto the most important British-controlled copper company in the world. Reports from the start of operations indicate that results will equal expectations.

It is stated by Rickard that the leaching plant for Katanga will yield thirty to thirty-five thousand tons of copper per year, the transportation cost of which, via the Rhodesian Railway to Beira plus an ocean freight of about $8, will amount to about 3c. per pound. A railway to Benguela, to be completed in 1927, will make an important reduction in freight costs. Unofficially it has been stated that the total cost of production will be in the neighborhood of 9½c. per pound of copper.

Heap Leaching of Ore

Heap leaching of ore or tailings and leaching underground involve practically the same dissolving and precipitation principles. A. W. Hudson, in charge of operations, has described[2] the operation to date of the Copper Queen heap-leaching plant at Bisbee. This is a minor operation with respect to tonnage of copper produced, but is of considerable importance in view of the possibility of application of the method elsewhere, and is of interest by reason of being the first direct large-scale application of the method in this country for the beneficiation of low-grade siliceous material. After about two years of operation, the installation can be said to have passed the experimental stage. Extraction figures have appreciably exceeded estimates made before starting, and from the cost figures given results would appear to be commercially satisfactory. The total leaching ore to be treated is estimated to amount to about 8,500,000 tons, averaging about 0.72 per cent copper, two heaps being at present under construction, with a total piled of 1,800,000 tons and 935,000 tons, averaging 0.92 and 0.72 per cent copper, respectively.

A good description of the underground leaching operations of the Ohio Copper was published in the *Transactions* of the Institute. An important practical detail described was the briquetting under heavy pressure of the cement copper made, apparently a successful solution of the troublesome transportation and treatment problem of this material.

[2] M. C. J., Oct., 1926.

The success of underground leaching on broken material has led in one or two localities to consideration of whether unbroken ore can be leached in place and to tests on a good-sized scale to answer this question. It should be noted that while Tobelmann gives limited fresh-water supply as the reason for the use of launder tailings solutions, it has nevertheless been found necessary to add some acid to the water supply distributed over the caved area, which will help to prevent iron precipitation and plugging up and will dissolve oxidized copper. This is good practice for another reason—pure water is not a copper solvent either in the slow processes of nature or in the vastly accelerated operations of heap and underground leaching, which are closely similar in principle to the natural processes that formed oxidized and mixed copper orebodies.

Japanese operators have acquired rights for the Thornhill-Anderson method of making sponge iron, and it is stated that a plant with a capacity of 70 to 100 tons of iron per day is to be erected. New Cornelia Copper made no change of importance in the company schedule during 1926, and nothing of news interest has been published regarding changes in South American leaching practice. It has been stated that the profit margin of the Pike process as against shipment, smelter treatment, and other items is not large for the treatment of the concentrates of the Engels Copper Co., which made a thorough investigation and test of the process.

New Zinc-Leaching Plants

In zinc leaching, announcement was made of the construction by the Sullivan Mining Co. at Kellog, Idaho, of a zinc plant of an initial capacity of 50 tons of metal per day. Responsibility for the plant design is to be with the company's staff and U. C. Tainton. It is estimated that the plant will be in operation in a year and will embody the developments of high acid solutions, high current density, mechanical agitation and other novel features, the pioneer advocacy of which was due to Tainton.

During the year an exhaustive investigation of the metallurgy of the ores of the Flin-Flon mine, in northern Manitoba, was made in Denver under the direction of R. E. Phelan for the Whitney interests. Details of the method finally adopted are awaited with interest.

Two pilot plants are in operation for the removal of zinc from zinc-lead materials—the Coolbaugh and Gordon-Keith processes. Both, of course, involve a preliminary roast, one producing zinc sulphate and the other a zinc oxide product. Details of commercial results are not available for either method.

The roasting reactions and results of the Coolbaugh process may be expected to become of importance both for zinc and copper roasting. The equation $3ZnSO_4 + ZnS = 4ZnO + 4SO_2$ is illustrative for zinc compounds. As carried out in the usual multiple hearth furnace, sulphating roasting results in the formation of large amounts of sulphates in the upper hearths. If raw sulphides are now added to the lower hearths and the temperature is kept at about 600 deg. C., the oxygen carried down in sulphate combination may be made available and desulphurization of the calcine accomplished more or less in proportion to the amount of raw sulphides added. Obviously this means appreciably increased furnace capacity, and, since the reaction between sulphides and sulphates is endothermic, heat control without overheating is facilitated and this in turn results in minimum ferrite formation. Favorable conditions also exist for the decomposition of ferrites formed in the upper hearths. It is stated that no extraneous fuel is required if the sulphur content of the charge is 20 per cent or more.

The process and mill of the Chief Consolidated Mining Co. were described in the Institute *Transactions* by G. H. Wigton. The method is interesting in that volatilization of lead, silver, and gold is accomplished without the usual addition of salt. Obviously the higher temperatures necessary can be applied only to ores which do not seriously slag or sinter at the required temperature, as has been pointed out by O. C. Ralston.

The chloridizing mill of the Standard Reduction Co. was also described by H. P. Allen and W. C. Madge, who state: "The process consists essentially of a chloridizing roast (in the Holt-Dern furnace), followed by a percolating leach consisting of a nearly saturated solution of common salt, acidified with sulphuric acid; precipitation of silver on sponge copper and of copper and lead on tin cuttings. . . . The process was revived in the district by Theodore P. Holt, N. C. Christensen, the Bureau of Mines, and others."

The pilot plant using the Tainton method of lead leaching and electrolytic precipitation in a diaphragm cell with evolution and utilization of chlorine and other products is still in operation. In the Southwest tests have been made on a method[3] of lead leaching and precipitation involving principles of depolarization and utilization of the solvent action of the ferric iron made, with successful results in simple standard apparatus.

Cyanide Practice Improves Details

In cyanide practice, U. C. Tainton recently developed an electrolytic method of cyanide regeneration which promises excellent results. It seems probable that the Hardinge company's superthickener, being installed in a number of localities, will have considerable influence in future cyanide flow sheets, perhaps as a compromise between countercurrent decantation and double filtration at less installation and operating cost than for filtration. Hanson[4] summarizes the outstanding improvements in northern Ontario cyanide practice as follows: Primary crushing underground; finer grinding of sulphides; filter installation to reduce dissolved gold loss; double filtration; and pachuca agitation.

Further progress was made in the regeneration of cyanide. The cyanide plant of the Mexican Corporation, Fresnillo unit, has been using Merrill's cyanide regeneration system for about a year and Santa Gertrudis for about two years, and during the last year the Real del Monte Co., at Pachuca, experimented with the process, having in view its adoption. At Tonopah the Halvorsen process was in operation for some time at the Tonopah Extension mill and at the West End mill. During 1926 experiments were conducted in electrolytic precipitation and cyanide regeneration.

Selective classification with finer grinding of the heavy minerals resulted in improved extractions in a number of cyanide plants, such as the Dos Estrellas, in Mexico; the McIntyre Mines, in the Porcupine district in Canada; and plants on the Witwatersrand, in South Africa. Bowl classifiers operated in closed circuit with fine-grinding mills have shown a greater concentration of the heavy minerals in the return to the ball

[3]Flynn-Van Arsdale process, U. S. Pat.
[4]*Engineering and Mining Journal*, July 17, 1926.

mill than the simple mechanical classifier or cones, with the result that the heavy minerals are ground finer when the bowl is used.

Use of flotation for the recovery of tellurides is becoming general at Kirkland Lake. Concentrates are treated with bromo-cyanide or by roasting and straight cyanidation before being returned to the mill circuit. Finer grinding is also a development of interest in this district. Bowl classifiers are being used for the purpose at the Lakeshore, Sylvanite and Teck-Hughes—at the last-named property with the intention of grinding to 300 mesh, a step justified and made necessary by the extremely high-grade ore under development.

The use of continuous filters has become general for final dewatering. At some new plants where conditions are favorable, series filtration has been adopted with agitation and thickening in some cases to give a change of solution between filters.

Generally speaking, notwithstanding present improved flotation practice, there remain problems the solution of which belongs to the province of wet methods, and the outlook for hydrometallurgy is therefore good. Taking copper as an example, leaching methods are well equipped to meet price depression and potential or actual overproduction, because under any reasonable conditions their product is low-cost metal.

SMELTING TECHNIC *Makes Moderate Advances*

Double-Sintering Roasting Finds Favor—New Lead Smelter in Arizona

By Edward P. Mathewson
University Station, Tucson, Arizona

JUDGING by the financial returns to stockholders, smelting plants were prosperous during 1926. Nearly all the large smelting companies increased their dividends. Construction of extensions to existing plants was noteworthy in the year just past.

E. P. Mathewson

The Consolidated Mining & Smelting Co. of Canada has started work on an eighty-ton capacity addition to the zinc department, bringing up the total capacity to 280 tons daily. A new fifty-ton addition to the lead plant was put in operation in October. The Dwight-Lloyd sintering furnaces were remodeled and enlarged, increasing their capacity individually 240 per cent. The double sinter now forming the greater part of the charge for the lead furnaces has increased their capacity materially. It is stated that four blast furnaces have turned out as much as 125 tons each of lead bullion daily for a month at a time. The percentage of lead in the charge is very high, but the slags are said to be clean. The success of the Consolidated in the treatment of large tonnages of zinc-lead complex ores is the talk of the metallurgical world. Tin is an interesting byproduct now being produced by this company.

The Copper Queen smelter of the Phelps Dodge Corporation at Douglas, Ariz., is being remodeled on plans that will, it is believed, materially lower the cost of operation, the chief novelty being that the roasting furnaces and boilers are superimposed above the reverberatories. The design contemplates the transfer of the hot calcine from the roasters to the reverberatory furnaces with the least possible loss of heat and with no dust loss. It is hoped to have this remodeled plant in operation early in 1927. The Phelps Dodge Corporation also announced that it will immediately begin the construction of a lead smelting plant as well as a concentrator to handle complex lead-zinc ores, not only from its own properties but as a custom plant.

The Electrolytic Zinc Co. of Australasia has also added to capacity during the year. Bwana M'Kubwa has now in operation a 1,000-ton plant utilizing the process devised by Walter Perkins and associates for leaching copper ore after a special heat treatment.

The Utah smelters made improvements and additions to their plants. Nearly all the lead-smelting plants which have rich lead concentrates to treat have changed or are changing their sintering practice to double sintering, in many cases eliminating the sulphur almost entirely. Lead blast furnaces working on the double-sintered charge are putting through tremendous tonnages and at the same time are making long campaigns in spite of considerable zinc in the charge.

The American Zinc, Lead & Smelting Co. made notable improvements, it is reported, in its East St. Louis plant, but up to date no details have been given out. Powdered-coal firing, using the Fuller-Lehigh system, has proved a great success on all furnaces of the U. S. Metals Refining Co.'s refining plant at Chrome, N. J., and it is rumored that the officials of the Baltimore refinery of the American Smelting & Refining Co. are also thinking of adopting it. The American Smelting & Refining Co.'s lead refinery at Perth Amboy was largely remodeled during 1926 in connection with the installation of the Harris process. This process of refining lead bullion has been adopted by several plants in the United States and abroad, and the National Lead Co. has purchased a license for the treatment of lead secondaries by this process. Noranda Mines, Ltd., has begun construction of a smelter near its Horne mine. The estimated cost of smelting the Noranda ore is $5 per ton.

Four copper-smelting companies are now operating in Chile: Chile Copper, Braden, the Chagres Copper Co., and the Naltagua. The Andes starts early in 1927.

Developments of the last year indicate that the Rouyn district, Quebec, Canada, is likely to become prominent in the near future as a copper producer.

The Anaconda Copper Mining Co. formed a new corporation known as the Silesian-American Corporation, with Cornelius F. Kelley, president of the Anaconda Copper Mining Co., as president, to acquire from Georg

von Giesche's Heirs Mining Co., a German corporation, all of the capital stock of the Giesche Co. Anaconda will thus control about one-sixth the zinc output of the world. Exhaustive tests by Anaconda engineers upon the Silesian ores caused the formulation of plans to substitute for the present mining and metallurgical methods the latest American treatment methods. Silesian ores consist of oxide and sulphide. With the oxidized ores it is proposed to volatilize lead and zinc as a high-grade fume, which will then be treated by the electrolytic process in use at the Great Falls zinc plant. The improvements should lower operating costs appreciably.

The Tennessee Copper Co., it is understood, is roasting and selling as iron ore the pyrrhotite tailing depressed in its flotation operations. This precedent will likely be followed by many other smelting companies whose ores contain barren pyrite. The Consolidated, at Trail, has already done much work along the same lines, but it contemplates producing electrolytic iron from its own pyrite.

The Sociedad Minas de Plata, de Caylloma, at Caylloma, Peru, has recently completed a chloridizing, blast-roast, re-treatment plant following the same general lines as the Tintic plant at Harold, Utah. It is, however, somewhat of a departure in that table and flotation concentrates averaging about 30 per cent sulphur are to be treated in the Holt-Dern furnace.

In all of the plants of the American Smelting & Refining Co. where ore receipts would justify the expenditure equipment has been added to handle increased shipments. At East Helena plant a new roaster and ore bins have been installed and repairs and improvements requiring an outlay of fully $100,000 have been made. The El Paso plant remodeled its lead department to take care of heavy shipments from Ahumada. The plant at Chihuahua has been totally rebuilt within recent years and is now one of the most up to date in Mexico. Garfield plant put on 200 additional men a few months ago on account of heavier ore receipts.

Mason Valley Mining Co.'s ores are being treated at the Thompson smelter, at Wabuska, Nev., which was started up Aug. 14, 1926. The Burma Corporation steadily increased its lead and silver output and also shipped some zinc concentrate to the works at Swansea Vale. At Anyox, the Granby company enlarged its sintering plant so as to sinter all the flotation concentrate, the product to be smelted in existing blast furnaces.

The Aluminum Company of America has been very active and has during the last year started construction of a large plant in the Lake St. John region of Canada. Bauxite is to be shipped by water from the company's holdings in British Guiana to the plant, and shipments of the finished product are to be transported by rail. An electrolytic zinc plant has been considered as a possible addition.

Some interesting work has been done in Utah and the San Juan by the International Smelting Co. and the U. S. Smelting, Refining & Mining Co. in building custom mills for selective flotation of complex lead-zinc ores with the twofold object of getting additional lead tonnage for their smelting plants and the lowering of zinc content of their lead blast-furnace charges. The results have proved that the plan was well thought out.

Carson's patent litigation continues. The American Smelting & Refining Co. attempted unsuccessfully to get a hearing before the Supreme Court. The case of the Carson Investment Co. vs. Anaconda Copper Mining Co. was heard before Judge Bourquin in the Federal Court at Butte, Montana, early in October. No decision in this case can be expected for several months. In the meantime cases against other companies which the Carson interests claim are infringing have been continued. In the review of pyrometallurgy for 1925 mention was made of many settlements with the Peirce Smith Converter Co. It is understood that the United Verde Co. has also settled.

Considerable research work is being undertaken. For example, the Engineering Foundation has been recommended by the American Institute of Mining and Metallurgical Engineers to make an appropriation to aid Professor R. S. McCaffery, head of the department of metallurgy at the University of Wisconsin, in continuing a study of blast-furnace slags. Colonel H. H. Stout and associates at Clifton, Ariz., have been carrying on interesting experiments to produce a purer copper, which it is believed will bear the same relation to electrolytic copper that electrolytic zinc does to Prime Western.

A. J. M. Sharpe, in his review of world zinc conditions on April 1, 1926, for the American Zinc Institute, mentions several processes that have been tried in Europe, no one of which has yet reached commercial stage. Among those mentioned are the Waelz, Elmore, Coley, and Ashcroft, which are said to look promising.

The *Mining Journal* of London says, regarding the Coley process:

> "It is based on the employment of carbon in its most active condition as a reducing agent, and so successfully has this point been developed that the reduction obtained is achieved at a temperature of about 300 deg. C. less than the temperature employed in the present zinc-smelting operations. The ore is passed through a revolving tube composed of a special alloy, and during its passage through the tube it is maintained at a temperature of between 1,000 and 1,100 deg. C. The tube is externally heated, and the nascent carbon employed as a reducing agent is obtained by injecting into the heated ore any suitable hydrocarbon in such a manner that it is uninfluenced by the heat until it is in contact with the ore, when it cracks into its component parts of carbon and hydrogen, with the result that the carbon, being in an extremely active condition, reduces the oxide of zinc present in the ore by the formation of carbon monoxide. The zinc so formed is vaporized and passed out of the tube in a continuous stream of vapor, which is condensed and converted into zinc. The tube is sealed by suitable devices, with the result that no air of any kind is introduced into it, and consequently no re-oxidation of the vaporized zinc takes place, unless it is desired to produce the zinc oxide. It has been found possible, as we have said, to treat not only high-grade zinc blendes but mixtures of zinc blende and calamine, and also low-grade blendes or calamines containing even less than 20 per cent of zinc. The extraction obtained on a commercial scale is practically the maximum possible, and it is expected that from medium and high-grade ores an extraction of from 95 to 98 per cent of the zinc contained will be continuously obtained, while from low-grade ores 90 to 95 per cent will be recovered."

Numerous leaching plants for the treatment of oxidized ores produce byproducts and residues which must be treated by pyrometallurgy. The United Verde Extension and Union Minière du Haut-Katanga bought interests in the Nichols Copper Co., as recorded in the *Engineering and Mining Journal* in the issue of June 26, 1926.

[Mr. E. P. Mathewson presents an excellent bibliography of pyrometallurgy during 1926, and this will be published in an early issue of the *Engineering and Mining Journal*.—Editor.]

PROGRESS *in Iron and Steel Metallurgy*

Increase in Unit Capacities—Wider Application of Iron Alloys

By James Aston
Carnegie Institute of Technology, Pittsburgh, Pa.

A YEAR spans a small gap in industrial history. Some years have covered the beginning of epoch-making processes in iron and steel manufacture, distinctive theories, and technique in practice, control, or testing. However, most years are principally a record of progressive development. The year 1926 falls into this niche.

James Aston

From a production standpoint 1926 has been noteworthy, despite pessimistic predictions at the outset. Shipments of Lake Superior ore and production of pig iron will closely approach high records; and steel-ingot output should exceed the 1925 peak of 44,188,000 tons. Paralleling trade demand in the United States, Continental Europe is making record production of pig iron and steel. Great Britain alone is operating at a reduced rate, and has been a purchaser of steel in foreign markets. During 1926, for the first time in history, the British makers of ferromanganese were eliminated in the American market in the bidding for the contract business of the year, the tonnage going to three domestic manufacturers.

High-grade ores from the Lake Superior district dominate the American steel industry. The known limited life has concentrated attention upon beneficiation to utilize competitively the practically inexhaustible low-grade ore reserves of the district. During 1926 a permanent organization representing iron-ore interests was effected to advise and co-operate in research activities. Beneficiation has already assumed an important place, and fully one-third of present shipments from Minnesota are thus prepared.

There have been outstanding accomplishments in steel plant operation. Satisfactory blast-furnace coke is now successfully produced in byproduct ovens from 100 per cent high-volatile coal. Coking temperature is considerably above that heretofore used and thought feasible; and careful control of temperature and oven conditions is exercised. Readjustment of blast-furnace conditions has been made necessary by the changed physical characteristics of the coke, but with resultant satisfactory operation and tonnages markedly beyond those attained under former conditions. This achievement has enabled the Pittsburgh district to utilize near-by coals, and has restored the cost equilibrium which had been upset in favor of the Chicago district because of its advantageous position with respect to ore.

Interest in blast-furnace operation is centered upon enlargement of hearths. Greatly increased tonnages are being obtained, in some instances topping 1,000 tons of basic pig in one day from all-ore charges. Daily records of 800 tons and upward from furnaces of previously lower rating are quite prevalent. In line with the blast-furnace situation, open-hearth outputs have shown a steady increase, and there is a drift toward larger furnaces. At Weirton, W. Va., three stationary furnaces of 250 tons' capacity have been placed in operation. Purification of the gas used as open-hearth fuel is being resorted to, chiefly to reduce its sulphur content. As a paper by Herty indicates, sulphur transfer to or from the charge is, in general, proportional to sulphur content of fuel used.

Never has there been greater concentration upon investigations tending toward improvement of the quality of steel. Fundamental research is being fostered in well-equipped laboratories by steel companies and by co-operative effort. An important research has been launched on the physical chemistry of steel making, under a co-operative relationship between the U. S. Bureau of Mines, the Carnegie Institute of Technology, and a group of representatives from prominent steel companies. A study of inclusions in steel is an outstanding topic for the immediate future. Similar interest is manifested abroad, and a committee of the British Iron and Steel Institute has presented a report on a study of the problem of inclusions in steel and the heterogeneity of ingots.

The magnitude of the loss due to corrosion attracted attention, and it was a live topic of discussion at many technical society meetings. Important investigations under service conditions are being conducted by the U. S. Bureau of Standards, the American Society for Testing Materials, and the American Society of Refrigerating Engineers. More resistant materials, protective coatings, and improvement of service conditions are the problems of major interest.

High-chromium, low-carbon, stainless iron, so called, is steadily broadening its fields of utility, although its high cost is a deterrent in the most important fields of structural and pipe service.

Interest is particularly keen in alloy steels. In this country pearlitic manganese steel, of less than 0.40 per cent carbon and 1 to 4 per cent manganese, is being actively investigated, as a possible lower-cost substitute for nickel, chromium, and other special alloy steels.

A process for cementation with nitrogen is being introduced into this country. It had its origin in the Krupp organization in Germany, and promises to bring about revolutionary results in case carburizing. By the introduction of nitrogen into the carburizing atmosphere, a greater uniformity is claimed, together with a much greater surface hardness than ordinarily obtainable. Important studies are in progress at the U. S. Bureau of Mines, the Bureau of Standards, and under the auspices of the American Society for Steel Treating, on the mechanism of case carburizing and the causes of abnormalities in the operation. Indications point to certain inclusions in the steel as one probable cause.

Magnetic testing as an aid to the inspection of the quality and treatment of steel made notable advances

and was an important topic of discussion before the American Society for Testing Materials. It has now been developed into a sensitive test of great value in some fields of manufacture.

Metallographic research was exceedingly fruitful in published results; so much so that detailed consideration is beyond the scope of this review. It is of interest to note several publications of comprehensive investigations conducted at the Japanese Research Institute for Iron, Steel, and Other Metals under the direction of Professor K. Honda. These, together with a prospectus recently issued, illustrate the valuable work being done and introduce an important contributor from a new quarter of the globe.

W. P. Sykes published data on the constitutional relations in the iron-tungsten system. In some important phases his results confirm deductions of Bain in his study of the iron-chromium system and throw light upon the phenomena of hardening. Lucas, in addition to his contributions in the field of high-power microscopy, resorted to ultra violet light for illumination, claiming thereby greater selective properties and resolving power which will aid in examination and identification of structures. Professor Sauveur, before the American Institute of Mining and Metallurgical Engineers, summarized our present knowledge and theories of the hardening of steel.

Steady progress is recorded in the examination of structures by the use of X-rays, the spectroscope, and high-power microscopy. The studies are no doubt of great assistance in a better understanding of metals and alloys. In the industrial field, however, it is improbable that they will be of material aid in improvement of treatment or practices, except perhaps as they may point the way in the development of valuable alloying relationships in hitherto unsuspected directions.

REGIONAL SUMMARIES

UNITED STATES *Mining States Maintain Activity*

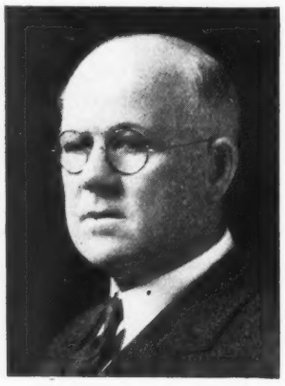
Increased Ore Tonnages—Decreased Costs—Increased Dividends

By Albert H. Fay
Assistant Editor
Engineering and Mining Journal

MINING OPERATIONS were satisfactory in 1926 in tonnage of material, but prices in some instances were not so good. Producers of iron ore feel that prices should have been higher, but the largest tonnage since 1918 was produced. The same may also be said of copper. The slump in silver quotations was felt severely by companies whose major production is silver, and those which produce silver as an important byproduct have had their net earnings reduced. Lead and zinc earnings were maintained by good prices and improved metallurgical methods. General condition of the industry is best reflected by the payment of $239,000,000 in dividends in 1926, compared with $203,000,000 in 1925 and $177,000,000 in 1924. Quantity production, improved mining equipment, and increased metallurgical efficiency are principally responsible for increased dividends.

Alabama.—Iron-ore production was the largest in the history of Alabama in 1926. The pig-iron yield was approximately 2,940,000 tons, compared with 2,819,000 tons in 1925. Cement, brick, clay, and marble industries experienced a good year.

Alaska—Beginning of an extensive gold dredging by subsidiaries of the U. S. Smelting, Refining & Mining Co., in the Nome and Fairbanks districts, was the outstanding mining development in Alaska during 1926. At Nome the Hammon Consolidated Gold Fields Co. operated Yuba dredges. The Fairbanks project is the most extensive gold-dredging enterprise yet attempted in the Northland. Work during the summer was chiefly concentrated on the 74-mile ditch, to bring water into the district for ground sluicing.



Albert H. Fay

Kennecott Copper Corporation produced the bulk of Alaska copper during 1926 from its mines at Kennecott and Latouche. The Alaska Juneau mine, at Juneau, is the only large low-grade gold mine now operating in Alaska. Lode-gold production was swelled from several smaller mines at Chichagof Island and other points along the Southeastern Alaska coast. The Hope and Willow Creek districts near Anchorage, the Fairbanks district, and the Kuskokwim area also made production. Small shipments of stream tin and of mercury were made. The marble quarry at Tokeen was busy during 1926. The Alaska Railway reports an increase of passenger and freight business.

Arizona—The mining industry in Arizona enjoyed fair prosperity in 1926. Encouraging results in exploration work were achieved in the copper and gold districts. The most important copper ore discovery was at Warren, where the Calumet & Arizona Mining Co. drifted through an orebody which is from 15 to over 100 ft. wide and which assays from 5 to 14 per cent copper. This discovery influenced the Phelps Dodge Corporation to make plans to sink a 2,500-ft. shaft on its property near the new strike. The United Verde Extension Mining Co., of Jerome, also became interested in the district and appropriated $200,000 for exploration work there. Miami Copper Co.'s annual report for 1925, issued in the spring of 1926, showed an ore reserve of 70,000,000 tons. The mill is now handling 11,500 tons per day. In Mohave County several new gold mines were opened and others increased production.

The most important construction work in Arizona in 1926 was completion of the $6,000,000 leaching plant at Inspiration. The Phelps Dodge Corporation is to build a lead smelter at Douglas and a lead concentrator at Bisbee. New concentrators placed in operation were as follows: Old Dominion at Globe, 300 tons; Aravaipa Mining Co., at Aravaipa, 150 tons; Big Jim, at Patagonia, 150 tons; Gold Dust, at Oatman, 50 tons; Chloride Mining Co., at Chloride, 300 tons; Central Copper Co., at Dos Cabezas, 500 tons; Goldroad, at Oatman, 100 tons.

California—Value of gold, silver, copper, lead, and zinc produced at mines in California in 1926, according

to the U. S. Bureau of Mines, was $19,078,000, a decrease of $4,206,354, or 18 per cent, from the record for 1925. Decreased yields were 11 per cent in gold, 44 per cent in silver value, and 34 per cent in copper value, but increases of 13 per cent in lead value and 38 per cent in zinc value were made. Gold production was 565,000 oz., valued at $11,680,000, a value decrease of $1,385,330 from 1925. Output of placer and deep mines was less than in 1925, but the dredge output was nearly as large as in 1925. Silver production was 1,911,000 oz., compared with 3,054,416 oz. in 1925. California Rand Silver was not productive after September, which accounts for part of the decrease, but the large decrease in copper ore mined also affected silver adversely and lead ores shipped in 1926 were not so rich in silver as those produced in 1925. Copper production was 31,590,000 lb., valued at $4,360,000, compared with 46,864,913 lb., valued at $6,654,818, in 1925. Yield from Shasta County mines was much smaller. Neither the Engels nor the Walker, in Plumas County, was as productive as in 1925. The Calaveras Copper Co. and the Island Copper Co. each increased its output.

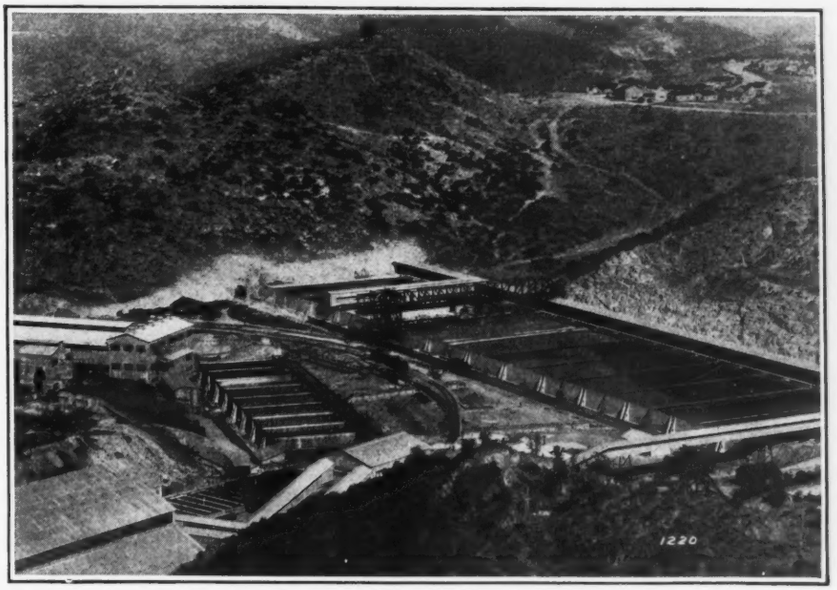
Lead mines of Southern California increased production to 7,750,000 lb., valued at $643,000. The Ophir was the largest lead ore producer, followed by the Tecopa and Darwin, besides other lead mines in Inyo County. Zinc production amounted to 16,370,000 lb., an increase of 4,880,763 lb. compared to 1925. Largest producers were the California Zinc Co. and the Santa Catalina Island Co., both companies increasing output.

Colorado — Metal-mine products of Colorado totaled $61,000,000 in 1926, a great improvement over 1925. Gold production will be around $8,000,000 and silver $4,500,000. Lead and zinc substantially increased. Production of vanadium, molybdenum, and tungsten continued. Diamond drilling near Cripple Creek on the Stratton estate marked the first attempt to explore this highly mineralized area.

An important consolidation was the passing of the United States Vanadium Co. to the Union Carbide Corporation. International Smelting & Refining Co. resumed activities at Rico, Colo., on Nov. 1, 1926. The tungsten industry employed 50 per cent more men than in 1925, and molybdenum mines in the state increased production 100 per cent. The dewatering project at Leadville is well under way. Important discoveries were reported from Aspen and Gilpin. Selective flotation and more general knowledge of geological structure resulting from field work of the U. S. Geological Survey are probably responsible for improved conditions in Colorado.

Georgia — The Cartersville district was the largest producer in Georgia in 1926, the minerals being barite, ochre, lime, limestone, and crushed slate for roofing material. Manganese production was small and pyrite mines were inactive. General building conditions throughout the country sustained demand for Georgia marble.

Idaho: Coeur d'Alene District—The event of 1926 was beginning of construction of a 50-ton electrolytic zinc plant at Kellogg by the Sullivan Mining Co. (Bunker Hill & Sullivan and Hecla), to be completed in 1927. This unit will be followed by construction of two others that will provide capacity for custom ores of the district. A great impetus to the development of complex lead-zinc ores, particularly on Pine Creek, has resulted. The Bunker Hill & Sullivan company remodeled a 400-ton unit of the Sweeny mill for handling Pine Creek ore on a custom basis.



New leaching plant operation at Inspiration

Increased depth and reserves resulted from extending shafts at the Morning and Bunker Hill & Sullivan mines. The Hecla Mining Co. developed between the 2,000 and 2,800 levels a large addition to its ore reserves. At the Gold Hunter mine, at Mullan, a new ore shoot, parallel to the old one, was discovered by crosscutting on the 1,200 level, and promises to add many years to the mine's life. Four all-flotation mills in widely separated parts of the Coeur d'Alene district were constructed —the Jack Waite, of 150 tons' capacity; the Snowstorm, near Mullan, of 100 tons' capacity; the Galena, near Wallace, of 150 tons', and the Page, near Kellogg, of 250 tons'.

All larger producing mines operated at capacity throughout 1926, and a number of new producers were added. Total value of the district's production in 1925 was $30,506,220, and the 1926 total should show a substantial increase.

Michigan (Copper)—Production of copper in the Michigan district in 1926 is estimated at 130,000 tons, 11,000 tons more than the 1925 output. Numerous improvements in equipment and methods were effected and the mines are in position to maintain minimum operating costs. Development was vigorously pushed and exploratory projects will be given more attention in 1927 than since the close of the war. A copper research committee will devise methods to reduce losses in treatment and to utilize low-grade copper rock.

Calumet & Hecla Consolidated started an extensive exploratory project to reopen the old Cliff property. It completed a new electric pump system in Tamarack No. 5 shaft. Extensive improvements in the smelting plant at Hubbell were completed. At Quincy, electric pumps and new boilers were installed in No. 6 shaft. At Mohawk, production during 1926 was brought up to maximum, this being the only property in the Michigan district at peak production. A third shaft was placed in operation at Seneca, and production brought up to 1,300 tons of copper rock per day. The Trimountain mine was put on a profitable basis after it had shown a deficit for six years. "Reduction of costs" has been the district's motto.

Iron Mining—Iron mining in Michigan and Minnesota is reviewed by Dwight Woodbridge on page 127.

Estimates of Iron Ore Shipped in the United States in 1926

U. S. Geological Survey

District	—Ore Shipped in 1926— Gross Tons	Value
Lake Superior:		
Michigan	16,728,000	$44,135,000
Minnesota	40,787,000	104,180,000
Wisconsin	1,244,000	3,169,000
	58,759,000	151,484,000
Southeastern states:		
Alabama	6,855,000	$14,507,000
Georgia	71,000	201,000
Missouri	120,000	525,000
North Carolina	15,000	32,000
Tennessee	137,000	316,000
Virginia	51,000	139,000
	7,249,000	$15,720,000
Northeastern states:		
New Jersey	209,000	$915,000
New York	662,000	3,163,000
Ohio	1,088,000	2,320,000
Pennsylvania		
	1,959,000	$6,398,000
Western states	1,174,000	$1,705,000
Grand total, 1926	69,141,000	$175,307,000
Grand total, 1925	63,924,763	$160,796,886

Tri-State—Trend of the Tri-State district is decidedly toward larger companies. Few sales were made during the year, and practically all were to large operators. The merger of the year was sponsored by Eagle-Picher Lead Co., through its subsidiary, the

Consolidated Lead & Zinc Co., whereby the latter was amalgamated with the Underwriters Land Co., one of the oldest companies. The Consolidated in turn spent approximately $1,000,000 for new holdings.

Cost reduction is the watchword of the larger units, such as the Golden Rod Mining & Smelting Co. and the Commerce Mining & Royalty Co., which have established central blacksmith shops. Steel for ten or twelve mines is handled by three or four men, where formerly two men at each mine were required. The Commerce company spent more than $250,000 for a central air plant and placed more than 12 miles of air lines to its various mines. The same company is now building a large electric power plant with which it hopes to obtain further reduction in costs. Marked increase in milling efficiency was recorded. The district is now producing more than 2,500 tons of flotation concentrates a week. Two years ago it was not producing 100 tons a week. Practically all of this material formerly went to tailing piles. More than thirty tailing mills are now operating as against five at the year's beginning. Mine output is slightly higher in 1926 than in 1925, most of the increase resulting from installation of flotation plants.

Montana—In Montana during 1926 the important announcement was made that the Anaconda Copper Mining Co. would immediately sink three shafts to the 5,000 level, the shafts being at the northern and southern ends of its properties and midway between, all to be equipped with electric hoists. During the year Anaconda enlarged the zinc plant and copper refinery at Great Falls, and the Montana Power Co. is installing another power unit on the Missouri River.

Commercial copper ore was found in the Rainbow vein on the 3,400, or deepest, level of the Butte & Superior Mining Co. The entry of the Lewisohn interests in developing the Otisco in the south-central portion of Butte; the developing of properties in the Butte Hill Copper Mining Co. in the northern part of Butte; the opening of the properties of the Craig Mining Co., and work being done by the Ardsley Butte Co. in the southwestern part are most important developments.

During the year the North Butte-Tuolumne merger was consummated and the "hill" properties of the merged companies were let out to leasers. There is some activity in the Neihart district, looking toward the consolidation of several properties. In the eastern part of the state the American Chrome Products was formed to develop the Benbow chrome ore claims. The company plans to install a refinery and manufacture commercial chrome products, and its program probably will be started early in 1927.

Production of minerals in Montana in 1926 will have a money value of over $60,000,000, a little higher than 1925. Leading mining companies did not increase production during 1926 nor do they contemplate any increase during the early months of 1927.

Nevada—Silver, lead, and gold mining in Nevada was fairly active in 1926. New districts were exploited, but most did not become producers. Small booms were numerous, but the orebodies were small and of low grade. Some new plants of 50 to 200 tons' daily capacity were constructed and are operating. At Tonopah production showed marked decrease in 1926 over 1925, with diminished profits, few important ore discoveries, and December production at the lowest of the year. Estimated production for 1926 is $2,000,000. On the Comstock, Comstock Merger Mines, Inc., Virginia City, milled about 38,000 tons of ore per month, with gross yearly production estimated at $2,100,000. After an exhaustive development campaign the company discontinued operations in December, and will scrap its plant. Flowery Mines operated continuously at 180 tons per day, with an estimated gross production of $7,000 per month.

Climax Molybdenum Co.'s 800-ton concentrator, Climax, Col.

Mill stands at portal of "White" tunnel. Ore from "Main" tunnel, 203 ft. above, is lowered on incline. Elevation 12,000 ft. Mt. Democrat in background

Smaller producing properties at Battle Mountain, Quartz Mountain, Jarbridge, Simon, Garfield, and Round Mountain maintained production. Other districts, including Tybo, Manhattan, Hawthorne, Eureka, Hamilton, Gold Circle, and Douglas, carried on exploration and mill construction and are now entering production. At Yerington, in Mason Valley, a 1,000-ton flotation plant was started in February, followed by the blowing-in of the smelter at Thompson in August. Neither plant has operated at full capacity, but helped the small operator.

Oregon—Value of gold, silver, copper, and lead produced in Oregon in 1926, according to the U. S. Bureau of Mines, was $334,300, a decrease of $96,453 compared to 1925. Output of gold decreased 28 per cent, largely because of the decrease in dredge yield. Output of copper increased 131 per cent and lead 113 per cent, compared to 1925.

South Dakota—Gold mining in South Dakota produced about $6,500,000 in 1926, Homestake being the only producer. This company's building program is nearly completed. The Spokane Lead Co. resumed operations near Keystone. Mica and feldspar production were about the same. The Maywood Chemical Co. shipped about 100 tons of spodumene to New Jersey. South Dakota's state-owned cement plant operated continuously.

Tennessee—The copper mines at Ducktown operated throughout the year, production being governed by the sulphuric acid market. Sintering machines for utilization of pyrite were installed, making another byproduct (iron sinter), sold to iron furnaces. The barite production at Sweetwater was normal.

Utah—Reports from Utah mining camps indicate that production during 1926 will exceed that of any year since the war. Dividends amounting to approximately $15,000,000 will be paid, compared to $12,690,170 in 1925. Prosperity during 1926 is largely due to installation and operation of zinc plants. The International Smelting Co.'s flotation plant at Tooele operated at capacity. The selective flotation plant at Midvale, United States Smelting, Refining & Mining Co., was increased to 750 tons and was a large factor in increasing production.

The Utah-Apex Mining Co. completed erection of a selective flotation plant for treatment of lead-zinc-copper ores and is now milling from 750 to 800 tons of ore daily. The Silver King Coalition Mines Co. increased its milling capacity from 350 to 750 tons. Concentration of ores at the plant of the Chief Consolidated Co. improved. One outstanding development at Bingham was increased production in the Utah Delaware mine. Other Bingham mines operated about the same as in 1925. The Utah Copper Co. reduced its production cost from 8.5c. a pound in the second quarter to 7.8c. a pound in the third quarter of 1926, and increased dividends from $1.25 to $1.50 quarterly, making the annual dividend nearly $10,000,000. The value of Utah non-ferrous metal production for 1926 will be about the same as in 1925, which was $82,701,394.

Wisconsin—The iron district in the northern part of Wisconsin maintained production and shipments in 1926. In the southern part at Platteville the principal zinc production was by the Mineral Point and Vinegar Hill companies. Recent developments indicate that increased profits are being won from extensive and deeper workings.

Mining Progress in Canada

Increased Activity in Exploration and Development

By Reginald E. Hore
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IMPORTANT for the future of the Canadian mining industry is the fact that recently there has been a great increase in activity in exploration and development. This work is being carried on aggressively. Several new mines are in the making; others are being put in condition for larger production. Prospecting is active in many districts and important discoveries have been made on several properties.

Nova Scotia—In Nova Scotia, coal mining is prospering after a period of great depression in 1925. The strike was happily settled and the return to normal production was hastened by the unusual demand for coal at Atlantic ports engendered by coal troubles in Great Britain.

Recently there was a renewal of interest in gold mining, and a few properties are now operated in a small way. No big gold mines are in the province, but for many years there has been some gold mining, and it is hoped that revival of activity may result in at least a modest production of gold. Proposed development of the lead deposit at Stirling is likely to result in production from this mine in the near future. Nova Scotia's greatest industries are coal mining and steel making. The coal mining industry is again prospering, but the steel industry is still experiencing hard times. Nova Scotia iron furnaces are supplied by ore from Newfoundland. Ore, coal, and flux supplies are good, and the position of the works on the sea is favorable for many markets. There is, however, little local market and recently competition of European products has made the Atlantic Coast trade in iron and steel unsatisfactory to Canadian manufacturers. There is a feeling in Nova Scotia that the steel industry will be given more protection against foreign competition, and when this is done there will be some chance of carrying on profitable operations. Reduced railway freight rates are being asked for and, if granted, should be an important factor in retaining some business in Canada that is now going to American mills.

Newfoundland—The Wabana iron deposits, in Newfoundland, are extensive, and the mining of them, which is submarine, is carried on successfully. Considerable tonnage is exported to Europe when the market is favorable. Notable results have been obtained in prospecting for other metals in Newfoundland recently, and a greater and more varied production will be recorded in a few years.

Quebec—In Quebec the outstanding new developments are those in the Rouyn and Saguenay areas. The chief productive mining industry is that of the Thetford area, where most of the world's asbestos is mined. A merger of several asbestos companies effected in 1925 placed the industry on a better footing, and it should prosper under ordinary market conditions. Developments on the Saguenay and at Rouyn indicate that in the near future metal production will take a more prominent place among Quebec's industries. The aluminum plant at Arvida is to be a very large producer. The Rouyn area in another year will be shipping gold, copper, and probably also zinc concentrates.

Quebec is already producing copper ore and has been doing so for many years, the Eustis mine being the principal producer. This mine is one of the deepest in Canada. Lead and zinc are also being produced in Quebec, and active explorations in Gaspe and in the Ottawa Valley will probably result in larger production of these metals.

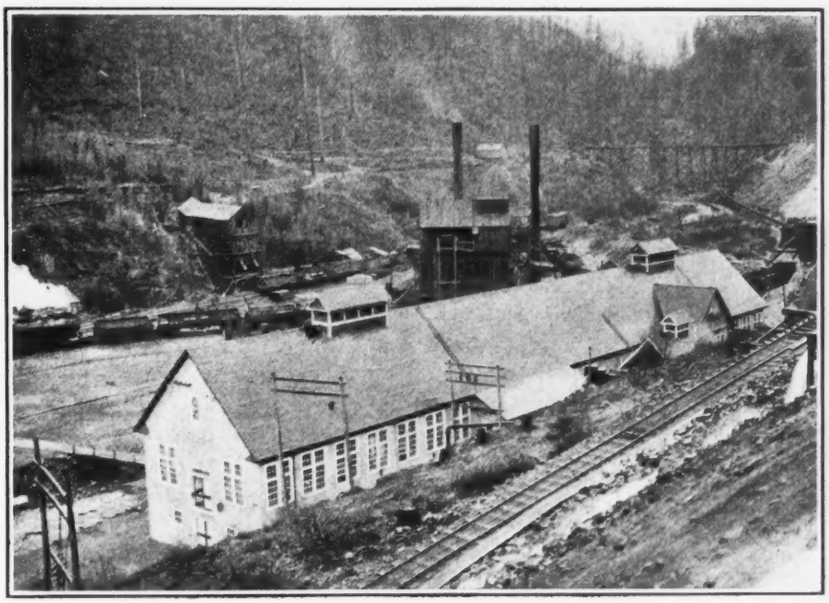
Ontario—In Ontario greatest interest during 1926 was in developments in the producing areas. Early in the year there was a rush to Red Lake which attracted wide attention and helped to show how much prospecting has yet to be done in northern Ontario. One discovery at Red Lake, the Howey, was tested by trenching and diamond drilling and found to be of considerable merit. Work was done under an option agreement by the terms of which a large price would have been paid for the property by Dome Mines, Ltd. The option was not exercised. Holders of other claims in the vicinity were naturally discouraged, and, except in a few instances, have not yet done much work on their holdings. Renewed prospecting is expected when work is resumed on the Howey property. During the summer prospectors working northeast from Red Lake made several gold discoveries, of which more will be heard in 1927.

At Porcupine, the Hollinger mine continued to increase production, but has not yet reached the efficiency toward which the management is working. Arrangements have been made at the Hollinger to fill stopes with sand, which will be brought to the mine by aërial tram. Many additions to equipment were made in the mill, including rod mills, filters and tables, and the tonnage of ore treated is steadily increasing. Two large electric hoists were installed at the main shaft, and at the mine preparations have been made with a view to increasing production.

At the McIntyre successful sinking of No. 11 shaft has been nearly completed. The shaft will go down to the 4,000 level, and is being equipped for high-efficiency service. The new hoist is being installed. Present McIntyre hoisting capacity is now taxed to its limit. The new hoist will serve a new section of the property and will also facilitate mining in the older section.

Great efforts are being made by the Dome mine to maintain production and exploration work is being carried on vigorously. At the Vipond the mill has been enlarged. The Ankerite and Paymaster have completed new mills and are in operation. At the Coniaurum, development work has given results indicating the advisability of installing a mill in 1927. At the West Dome Lake property some of the recent work at lower levels has been encouraging. On the whole, therefore, gold mining in the Porcupine area is making good progress.

At Kirkland Lake the gold mines have developed wonderfully during the past two years. The principal properties, Lake Shore, Wright-Hargreaves, and Teck-Hughes, have all greatly improved, and another property, the Kirkland Lake mine, was added to the list of profitable mines in this area. Encouraging results were obtained also at the Tough-Oakes Burnside property. At the Sylvanite a mill is now being



Compressor plant at Sullivan mine, Kimberley, B. C.

built, and the area will therefore soon have six producers.

Developments of the last two years have greatly increased confidence in the future of the Kirkland Lake gold mining. The striking of rich ore at 1,975 ft. depth in the Kirkland Lake mine in October, 1925, as a result of a campaign of deep level exploration, carried out under the supervision of J. B. Tyrrell, was a notable event, not only to those especially interested, but to the Kirkland area generally. Opening of wide rich orebodies on the Teck-Hughes at the 11, 12, and 13 levels gave this company good reason for increasing production. Neighboring producers are also progressing favorably and are increasing reserves as well as production. The Kirkland Lake gold area looks better than ever, and a long period of prosperous activity is assured.

At Cobalt silver production declined; but in spite of the lower prices considerable exploration is in progress. Gowganda and South Lorrain are partially making up for the falling off at Cobalt.

The Sudbury nickel-copper industry is prospering. The market for nickel and monel metal has greatly expanded during the last few years, and this industry is now on a more satisfactory basis.

Of new areas, the Michipicoten was brought into most prominence in 1926, through activities of companies managed by Dr. J. MacIntosh Bell. The new Pioneer Co., recently formed, has a promising gold property in this area, best known for its iron-ore production.

In many parts of Ontario prospectors have been active. Developments in the Rouyn copper area and copper showings are receiving much more attention than in past years. Copper and gold discoveries have been made in several places, and some of these will receive more attention during 1927. Work at some of the discoveries of 1926 will begin during the winter.

One of the most interesting recent developments in Ontario was the exploration for lead and zinc in the Sudbury area. Diamond drilling was carried on for several months. Very good results were obtained by the operators, and many properties in the area have been purchased from farmers and others. A shaft is now being sunk to open up the deposits at depth, and it is confidently expected that Sudbury will soon have a lead-zinc industry in addition to its nickel-copper industry. This outcome is due largely to activities of Joseph Errington, to the Bunker Hill & Sullivan company, and to associates whom he interested.

Manitoba — Two mining fields in Manitoba attracted attention in 1926. Recent announcements concerning Central Manitoba Mines, Ltd., assure that the province will soon have a regular gold producer.

Near The Pas is Manitoba's great deposit of sulphide ore, the Flin Flon. This is very large, but it is not high grade nor easily treated. Economic recovery of copper, gold, zinc, and silver in the ore is a problem now engaging the attention of the Whitney interest, which holds the property under option. Experimental work during 1926 gave good results, and a small plant is being installed to permit further investigation.

Canadian Mineral Production—Estimated for 1926

By S. J. Cook

Chief, Mining, Metallurgical and Chemical Branch, Dominion Bureau of Statistics, Ottawa, Canada.

	1925		1926	
Metals	Quantity	Value	Quantity	Value
Gold, fine oz	1,735,735	$35,880,826	1,729,377	$35,749,000
Silver, fine oz	20,228,988	13,971,150	21,907,496	13,618,000
Nickel, lb	73,857,114	15,946,672	67,551,300	14 401 000
Copper, lb	111 450,518	15,649,882	139,451,866	19,270,000
Lead, lb	253,590,578	23 127 460	281,044,548	22,911,000
Zinc, lb	109,268,511	8,328,446	147,814,074	10,845,000
Other metals	.....	4,177,862	.....	3,087,000
Total	.....	$117,082,298	.....	$119,881,000
Coal and other non-metallics				
Coal, tons	13,134,968	$49,261 951	16,105,000	$58,164,000
Asbestos, tons	290,389	8,988,360	272,000	9,777,000
Natural gas, M. cu. ft	16,902,897	6,833,005	18 576,000	7,841,000
Gypsum, tons	740,323	2,389,891	790,000	2,530,000
Petroleum, crude, bbl	332,001	1,250,705	339,000	1,335,000
Salt, tons	233,746	1,410,697	245,000	1,450,000
Other non-metals	.....	1,717,192	.....	1,908,000
Total	.....	$71,851,801	.....	$83,005,000
Structural materials and clay products				
Cement, bbl	8,116,597	$14,046,704	8,615,749	$13,200,000
Bricks and other clay products	.....	9,529,691	.....	11,000,000
Lime, bu	10,256,542	3,387,652	.....	4,000,000
Stone, sand and gravel, etc	.....	10,685,187	.....	11,800,000
Total	.....	$ 37,649,234	.....	$ 40,000,000
Grand total	.....	$226,538.333	.....	$242,886,000

Alberta—Alberta has a large number of coal mines; in fact, too many for the present market. The possibility of finding a wider market is receiving attention. Shipments made last winter to Ontario helped to make the fuel situation better understood, and continued effort to increase the use of domestic coal is expected to result in advantage to both central and western Canada. Alberta operators believe that with reasonable freight rates they can supply Ontario with fuel at attractive prices. It is to be hoped that this trade will be developed, for it will mean spending in Canada money that is now being expended for foreign coal. Alberta has also the distinction of being Canada's most promising field for oil exploration. Discoveries made during the last two years in the Turner Valley field, particularly the Royalite No. 4 Well, have revived hope of a real oil field.

British Columbia — Lead and zinc production in British Columbia has greatly increased during recent years, owing largely to the operations of the Consolidated Mining & Smelting Company of Canada. This company has the Sullivan mine as the basis of its principal ore source. The company's staff has succeeded in improving processes of treating the mixed lead and zinc ores and is now daily treating 3,000 tons at Kimberley, and will increase this capacity to 4,000 tons daily. The company smelts and refines the metals at Trail. The lead refinery has now a capacity of 400 tons per day, and the zinc plant of 200 tons capacity was increased to 280 tons.

There are a number of lead and zinc ore producers in the Kootenay district. The Consolidated company operates a custom concentrator as well as smelters and refineries, and this facilitates operation of smaller mines. Though the greater part of the lead and zinc produced in the province comes from the Sullivan mine, a score of other mines contributed some part of the 130,000 tons of lead and the 67,500 tons of zinc produced in British Columbia in 1926.

British Columbia is an important copper producer as a result of the operations of Granby, Britannia, and Allenby. Allenby, a subsidiary of the Granby, resumed operations in 1926, and is now shipping regularly to the Trail smelter. Granby, at Anyox, and Britannia, at Howe Sound, have their own smelting plants and are the chief producers. Both companies recently added to their ore-concentration equipment. At Anyox the concentrator is being further increased from 2,200 tons to 3,000 tons' daily capacity for treatment of the lower-grade ore. Higher-grade ore goes direct to smelting furnaces. Copper production was materially increased in 1926, and further increase is to be expected in 1927.

Some years ago Ontario became a greater silver producer than British Columbia as a result of developments at Cobalt and later became also the chief gold-producing province. In 1926 British Columbia regained its position as the leading Canadian silver producer.

Coal is one of British Columbia's chief mineral assets. The Vancouver Island district is the chief producer. Two of the operators, Canadian Collieries and Western Fuel Corporation, together produced a million tons. The Crowsnest district produced 900,000 tons. Smaller collieries brought the total for 1926 up to 2,208,000 tons.

Yukon — Yukon territory is best known as a gold producer. Recently, however, silver-lead mining in the Mayo district has attracted more attention than gold mining. Of changes in the gold areas, the most notable was the discontinuing of dredging and thawing by steam. Instead of dredges, steam shovels on caterpillar tractors are now used; and instead of steam points the more leisurely thawing by the summer's sun is utilized. With these aids, frozen gravel continues to give up a quantity of gold. Compared with the gold production of $22,275,000 in 1900, the present gold output of the Klondike is very small, but it should continue for many years.

Mexican mine workers

Mexican Mines Increase Production

Complex Ores Treated—Lead Output Increases

By George W. Tower, Jr.
Mining Engineer, Guggenheim Brothers, New York

MINING in Mexico in 1926 was generally profitable, and production of metals was, in most cases, in excess of that of previous years. Notable occurrences were the completion of several differential flotation concentration plants, the drop in the price of silver, and the enactment of a new Mexican Federal Mining Law.

The figures in the accompanying table are actual for the years 1924 and 1925. For 1926 the production is actual for the first nine months, and estimated for the remainder of the year. The data were supplied by the Mexican Federal Mining Department.

Gold production decreased, because of the closing of the El Oro mines of the El Oro Mining & Railway Co. in September and the reduced scale of operations at Tlalpujahua, Michoacan. Silver produced during the first nine months of the year was notably in excess of the production for the corresponding period in 1925, owing to increased production of complex lead, copper, and zinc ores. The production for the last three months seems to have been at a reduced rate, because of the necessary readjustments at some of the low-grade silver mines, caused by the sharp drop in the price of silver in September.

Lead production increased about 16 per cent, or from 196,000 tons in 1925 to 227,000 tons in 1926. This increase in production comes from working of new mines, resumption of operations at some "antiquas," and from introduction of selective flotation treatment of complex lead-zinc ores at both new and old properties.

Zinc production increased about 90 per cent, or from 57,000 to 110,000 tons, chiefly as a result of the erection or extensions of selective flotation plants at a number of mines; notably, San Francisco Mines of Mexico, Ltd., at San Francisco del Oro; Cia Minera Asarco, S. A., at Parral; and Industrial de El Potosi, Chihuahua; (all of these mines being in the state of Chihuahua); Cia Minera Asarco, at Charcas, San Luis Potosi; and the Mexican Corporation, S. A., at Teziutlan, Puebla.

The drop in the price of silver, which occurred in September, at first caused great concern lest a large number of low-grade silver mines might be forced to suspend operations, but adjustments and economies have been effected, which it is thought will meet the situation, at least for the time being. Production costs for many of the principal silver mines before the "drop" were reported as between 56 and 62c. per ounce, so that the problem of adjustment is considered most difficult and requires the sympathetic co-operation of all interested.

The new Mexican mining law, which went into effect Aug. 1, 1926, greatly limits the conditions under which mines may be developed and operated. Under the new law, it is now necessary, in taking up virgin ground, to apply for an exploration license, which, when minable ore is discovered, may be converted into a mining license that will be continued in force for as long as desired, provided the operator conforms to government regulations. Penalties for infractions of the regulations are either fines of varying amount or forfeiture of the mining license. Among other things, regulations limit the size of groups of claims, and provide a minimum scale of production for each claim or group of claims. Provision is made in the law for registration of pre-existing mining concessions, which, if effected before Aug. 1, 1927, will entitle the owners to continue operations with the full enjoyment of pre-existing rights and laws. The law limits the rights of states to levy taxes on mining rights and properties.

There has been great opposition to the law, but with the provision in the law for recognition of pre-existing rights and titles under the terms by virtue of which these were granted, it would not seem that these owners are seriously affected in their operations. What the effect of the new law may be on new enterprises and the continued development of the mining industry remains to be seen.

Chihuahua—There has been great activity, with substantial results, from explorations in Chihuahua. At Sierra de las Damas important new discoveries of high-grade lead ore are reported by not fewer than seven operators. In the Santa Barbara district four large properties are under development and exploration, in addition to the regular operations carried on by the established producers. At San Francisco del Oro, the San Francisco Mines of Mexico is increasing its mill capacity from 800 to 1,100 tons daily and is constructing a broad-gage railroad, 11 kilometers long, to connect with the National Railways between Parral and Santa Barbara. The company is also preparing the Clarines mine, west of Santa Barbara, for operation. At Santa Eulalia, the Carmen mine and Buena Tierra properties have been operated with satisfactory results, because of the discovery of new and important silver-lead orebodies. In Guadalupe y Calvo the General Mines Corporation began exploration of the Cebadillas mine. At Galeana, the Peñoles company has undertaken further exploration and development of the Candelaria mine. At Ahumada, in Los Lamentos district, the Asarco company and other companies have undertaken exploration of various properties.

Production From Mines of Mexico

	1926	1925	1924
Gold, oz.	753,757	788,993	792,401
Silver, oz.	93,235,000	92,885,176	91,437,944
Lead, tons	227,115	196,528	181,569
Copper, tons	61,820	60,056	55,068
Zinc, tons	105,050	56,974	27,125
Mercury, tons	45	43	40
Antimony, tons	2,668	1,473	852
White arsenic, tons	8,800	8,250	2,805
Graphite, tons	5,005	6,890	8,825
Manganese ore, tons	4,400	3,666	1,980
Coal, tons	1,100,000	1,588,948	1,393,366

Durango—At Guanacevi, development has been carried on at the San Rafael mine by the Peñoles company, and at Mapimi the Peñoles company has completed a new differential flotation plant with a capacity of 350 tons daily.

Guanajuato—The exploration by the Peñoles company of the Aurora mine at Zichu and remodeling of the mill for treatment of the complex ores of this mine should be noted.

Guerrero—At Campo Morado, the General Development Co. installed a semi-pyritic furnace of 250 tons' daily capacity, for treating the ores from the

Reforma and Narnajo mines. At Achotla the Peñoles company began the installation of a 300-ton plant for cyaniding the oxidized ores after they have been given a chloridizing roast. The installation contemplates an 80-kilometer power line, a 5-kilometer aërial tramway, and an 8-kilometer road. This will presumably be completed by the end of 1927. At Taxco, the International Ore & Smelting Co. has continued operating a small lead-zinc mine.

Hidalgo—At Pachuca the three large companies have been operating on the basis of a production of 190,000 tons per month, to yield 2,500,000 oz. of silver. Development work has been carried on from the working of these mines.

Jalisco—Development work has been carried on during the year at Ameca, at Guachinango, at Hostotipaquillo, at Pihuamo, and in the extreme northern part of this state in the Bolañas district. The well-known mines of Cinco Minas, Amparo, San Pedro, and Amalco have continued production with little change.

Nueva Leon—At Monterey, the Peñoles company reports having installed a new mechanical charging system in its smelter, and also that a part of the Harris system has been adopted in its refinery.

Oaxaca—The Peñoles company has put in operation a 175-ton daily capacity cyanide and flotation plant at Natividad mine, and the Asarco company is reported to have begun exploration at the San Juan Taviche mines, at Lachiquiri, in the district of Tehuantepec.

Puebla—The Mexican Corporation is now operating at Teziutlan on the basis of 5,500 tons monthly, having perfected a selective concentration plant for treating copper-zinc ores.

Sonora—At Cananea, the Green Cananea Copper Co. is reported to have made an important discovery of high-grade copper ore of different character and geological occurrence than previously known.

Zacatecas—At Zacatecas, the San Rafael property has been under development by a subsidiary of the St. Joseph Lead Co., and the Preeminente property has been under exploration by the Asarco company. The Chalchihuites property has been under development by the Shannon Copper Co. At Guadalupe, at the La Fe mine, a flotation plant has been erected by a subsidiary of the Union Corporation of South Africa, which is treating ores from Guanajuatillo. The Peñoles company began the construction of a smelting plant for treating ores and lead concentrates from the Veta Grande and other districts. The Pedernalillo company installed a 50-ton cyanide plant for treating the tailings deposited in the lake at that point. At Veta Grande, a subsidiary of the Carnegie Lead Co., a 200-ton cyanide plant for treating dumps of the old Veta Grande property was finished. Adjacent to this the Peñoles company has erected a 100-ton per diem plant for handling complex sulphide ores from the same mine. At Sombrerete, the Compania de Inversiones del Oro built, and is now operating successfully, an 8,000-ton cyanide plant to treat the ores from the Noria mine. At Concepcion del Oro, the Santa Rosa Mining Co. is treating successfully 2,000 tons monthly of gold-silver-lead ores of a complex character. At Fresnillo, the Mexican Corporation, Ltd., is cyaniding 90,000 tons monthly of low-grade siliceous ores and 10,000 tons monthly of complex silver-lead-zinc sulphide ores.

Cuba

By J. C. Porter

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A FLURRY was created recently in the Cuban iron field by the report that an agent acting for English capitalists has been scouting for bargains in iron-ore properties, and that the Italian Government has been considering purchase of some of the deposits still held by Cubans. It is believed that both of these movements result from the German attempt to syndicalize the iron holdings of the central European states with those of France, a move which might limit the ore supply of England and Italy.

The Bethlehem-Cuba Iron Mines Co. operated its drying and sintering plant at Felton, Nipe Bay, to about one-third capacity during 1926. The ore handled is hydrated limonite (plus some hematite) of lateritic origin, coming from near Mayarí. The company has also been conducting research work on the elimination of the nickel and chrome contents of this ore, and it is rumored that a feasible process for their removal has been worked out. The accompanying table gives estimated production and shipments in 1926.

Estimated Production and Shipments

	Long Tons Produced	Long Tons Shipped	From
Iron ore, Daiquirí and Juragua	400,000	500,000	Daiquiri
Nodulized iron ore	90,000	70,000	Felton
Chrome ore, Oriente	17,000	20,000	Felton
Limestone, Oriente	20,000	20,000	Felton
Chrome ore, Camaguey	13,000	8,000	Nuevitas

Where shipments exceed production, stockpiles of the previous year were drawn upon. All shipments were made to the Sparrows Point plant, near Baltimore, except a few cargoes of iron ore that went to Bethlehem, Pa., by way of New York.

During 1926 American interests acquired from Cuban owners approximately forty million tons of iron ore, occupying part of the old Cupey Estate lands lying to the east of Moa Bay.

Oil—Wells continue to be sunk to moderate depths at Puerto Padre, in north Oriente Province; at a few places in Camaguey Province and also in Pinar del Rio Province, all without result so far. The Motembo field of high-grade natural naphtha was given a mortal blow when the Cuban Government abolished the import duty on gasoline of about 10c. per gallon, replacing it with a sales tax of the same amount. The Motembo product was purchased by the West India Oil Co., of Havana, to enrich its gasoline and must now compete with imported gasolines. Its inability to do so has resulted in suspension of operations. The Union Oil Co. is still producing on a small scale from its wells at Bacuranao, near Havana.

Manganese—The Sun Development Co., of Oriente Province, shipped in 1926, through the ports of Santiago and Manzanillo, 7,473 long tons of about 47 per cent manganese ore from its deposit near Bueycito. Production has been suspended since Sept. 30, 1926, although the company is still developing on another deposit near Portillo, on the south coast of Oriente Province. At La Gloria, a deposit near Palmarito, north of Santiago, a little over 1,000 tons has been mined and shipped from Santiago to the United States.

Copper—Attempts were made to develop copper prospects, but these have all been failures, due principally to inadequate capital. The outstanding copper property of the island is the Matahambre mine, in Pinar del Rio Province. This property, owned by American and Cuban interests, has been operated by the American Metal Co. and has been a steady all-year shipper. The following figures summarize the estimated production for 1926 (includes ten months' production and two months' estimates): Tons (metric) mined, 247,169; tons (metric) ore sorted from foregoing, 17,573; tons (metric) concentrates from rejects, 39,045; total copper production, 26,087,706 lb. The ore as mined averages 5 per cent and hand-sorted ore averages about 18 per cent copper. Total average costs at this mine for 1926 show that the ore and concentrates have been placed f.a.s., Santa Lucia (the shipping port for this property, about 5.5 miles north of the mine), for about 6.10c. per pound of contained copper, and c.i.f., New York, for about 10.35c. per pound.

Central America

Editorial Summary

Nicaragua.—Two things conspired to make mining difficult for operators in 1926. Both spelled labor shortage. First, activity in timber operations in the first half of the year drew on the supply of men available for mine work. The effect was accentuated when revolutionary troubles began in the last six months. The year closed with the political dispute at the height.

Salvador—Mining continued at a standstill. Some prospecting was done at the Butter's Salvador Mines.

Honduras—The leading operator in Central America, namely, the New York & Honduras Rosario Mining Co., had a normal year, producing about 2,400,000 oz. of silver and 5,700 oz. of gold. Tonnage averaged in the last three months was about 10,500, the mill's actual capacity being between 12,000 and 13,000 tons monthly. Power shortage hampered operations and steps were taken to remedy this.

Costa Rica—The Abangarez Gold Fields of Costa Rica milled about 55,000 tons of ore, using flotation, and produced about $450,000 in gold. Labor was plentiful and conditions satisfactory.

Guatemala—The Las Quebradas dredge, operated by the New York Engineering Co., produced $299,671 in gold during 1926, making a total of $578,281.48 to date. Every assistance was received from the government. Several options held by the American Metal Co. in the Chiantla, San Sebastian and San Miguel districts, near Huehuetinango, were dropped.

South America Records Excellent Year

Petroleum Output Increases—New Zinc Production

Editorial Summary

SOUTH AMERICA again records a prosperous mining year. The only major mining industry in difficulty is the nitrate industry of northern Chile. Competition of synthetic nitrates that have made remarkable progress, both in simplification of processes and reduction in operating costs, was the principal reason for the difficulties of the nitrate producers, who were prevented by existing contracts from making prompt price readjustments necessary to meet the situation. Estimated Chilean nitrate production for 1926 is 2,148,000 long tons.

Political troubles in South America are restricted to the Tacna-Arica difficulty, which appears no nearer to a solution. Increase of taxation is becoming an important question, and mining industries are beginning to feel the drain upon their operating incomes from this cause.

Estimated copper production of Chile and Peru in 1926 is 247,000 tons, which is an increase over 1925. Of this amount it is estimated that 158,950 tons was exported to the United States. Bolivia is expected to just about maintain its lead production, which was around 40,000 tons in 1925. Peru is now a steady producer of lead concentrates. Zinc concentrates are also exported from both Peru and Bolivia. Bolivia produced 5,952,000 oz. of silver in 1926 and Peru 19,956,000 oz., or a total of 25,908,000 oz. for both countries. Total South American silver production, estimated at 30,000,000 oz. in 1925, will probably be exceeded in 1926. Colombian platinum production is expected to reach 62,000 oz. South American gold production, which is around $16,000,000 per annum, will probably be less in 1926. Chile exported an estimated total of 1,367,000 tons of iron ore, valued at $1,570,260, to the United States. Tin production in Bolivia is expected to approximately equal or possibly exceed the 1925 total of 32,980 tons (based on 60 per cent tin). British Guiana exported 159,384 tons of bauxite to the United States and Dutch Guiana 51,672 tons, a total of 211,056 tons for 1926. Manganese ore shipments totaling over 100,000 tons were exported from Brazil to the United States.

Petroleum production increased from 41,291,000 bbl. to 65,000,000 bbl. in 1926. Colombia increased its production to an important extent. Venezuela maintains its supremacy with an estimated production of 37,000,000 bbl.; Peru produced 11,000,000 bbl.; Colombia 5,000,000 bbl.; Argentina 7,000,000 bbl., and Trinidad 4,600,000 bbl.

Colombia—South American Gold & Platinum Co. operated two dredges steadily and started its No. 3 dredge that had suspended operation due to legal difficulties, on March 31, 1926. The estimated production of the company is 19,800 oz. of crude platinum and 5,400 oz. of gold. British Platinum & Gold Corporation operated most of the year, but damage was caused to one of its dredges by floods. Oroville Dredging operated its Pato and Nechi dredges. Late in 1926 the company decided to shut down its Constantia property, although a small profit was made during a part of the year; but deeper explorations were disappointing. In August the Constantia property reported an operating loss. Colombian Proprietary Gold operated more or less regularly, making a small gold production. Completion of the pipe line from the Infantas oil field to Cartagena during 1926 placed Colombia in a position to market crude petroleum and was responsible for the greatly increased oil production.

Venezuela—Chief interest was taken in the petroleum producing areas, current production being almost doubled. Although the La Rosa pool continues to be the chief producer, production is also coming from a number of other areas.

Guianas—Comparatively little of interest is reported from the mining districts. Both British and Dutch Guiana exported about the usual quota of bauxite. Some production of copper matte was made by the South American Copper Syndicate.

Ecuador — The gold-silver mines in the Zaruma district in Ecuador, operated by the South American Development Co. and the only mining operation of importance in that country, produced at a normal rate during 1926, the total production for the first ten months of the year being 50,000 oz. of gold and 80,000 oz. of silver. This was a substantial increase over the 1925 production for the corresponding period. A mill capacity of 250 tons per day establishes the mining rate. Gold production of Ecuador is slightly greater than the production of this company, for, although there are no other systematic operations, there is a certain amount of gravel washing by Indians, and the gold thus produced finds its way into local banks. At the company's mines, deep-hole drilling equipment was put in service for exploration during the year and both mining and milling methods were improved. A 300-hp. hydroelectric plant was completed and the equipment necessary for the Merrill cyanide recovery process was added to the mill. There were few or no changes in the political situation, but a commission headed by E. W. Kemmerer, of Princeton University, is now at work upon plans for a revision of the financial affairs of Ecuador. Railroad construction which was reported in the last *Annual Review* is progressing, the total grade construction being now about 115 kilometers, on 50 kilometers of which rails have been laid and trains are in operation.

Brazil—Both gold mines of Brazil, the Ouro Preto and St. John del Rey, operated continuously throughout 1926, the former at the rate of 4,062 tons per month and producing about 12,600 oz. of gold, and the latter at 15,500 tons per month, with an estimated production of 87,000 oz. of gold for 1926. A fair volume of manganese ore, about 102,748 tons, was exported to the United States.

Peru—Cerro de Pasco Copper Corporation estimated production in 1926 is 45,000 tons of copper and 16,000,000 oz. of silver, and since May the corporation has been shipping lead concentrates to Selby, Calif., and zinc concentrates to Antwerp at the rate of 1,000 tons per month each.

Lead concentrates average 45 per cent lead and 200 oz. of silver per ton; zinc concentrates contain 50 to 55 per cent zinc and 12 oz. silver per ton.

A lead smelter is now being erected by the corporation to treat its own lead concentrates and also some lead ore. The capacity will be 250 tons per day. A sintering plant erected for copper smelting, but never used for the purpose, will now be placed in service, and one of the copper blast furnaces will be replaced with a lead blast furnace. Reverberatory smelting is now used almost entirely for smelting copper ores. During 1926 the Cottrell plant on the converter flues was started, and about 600 tons per month of flue dust is being gathered, which will make a substantial return when exported or later when treated in the corporation's own furnaces.

Fume difficulties are over as well as claims for damages, which were settled by buying up all lands within a radius of several miles of the companies' smelting plants.

An experimental plant for treating low-grade silver "Pacos" ores was started in November. Its capacity is 50 tons per day. Definite results have not been obtained as yet, but the outlook is considered promising. If successful, a larger scale plant will be considered.

During 1926, the Northern Peru Mining & Smelting Co., a subsidiary of the American Smelting & Refining Co., continued development and operation of its various properties located in the Department of La Libertad. In the Quiruvilca district, the construction of the Shorey smelter to smelt ores from the Quiruvilca mine was practically completed and a system of aërial tramways was constructed to link together the Quiruvilca mine, the smelter, and the anthracite coal mine at Callacuyan, which will supply fuel for the smelter. The Quiruvilca mine was further developed and was placed in condition for extraction of ore for shipment to the smelter on its completion.

During the year, a mill of 80 to 100 tons' capacity was put into operation at the Pataz mine, located about 60 miles east of Quiruvilca. The mill produces a high-grade, selective gold-silver-lead concentrate for shipment and a low-grade iron concentrate, which is cyanided for gold. In the Milluachaqui district, the operation of the LaGuardia and Diana mines and their respective mills was continued and several new properties in this district were acquired. The development of the Chilete mine, located about 100 kilometers east of the port of Pacasmayo, was carried on during the year.

Vanadium Corporation of America exported from its Minasragra mines 7,123 tons of vanadium ore, valued at $892,160, in the first eleven months of 1926.

Chile—The Chile Copper Co., through its subsidiary the Chile Exploration Co., produced slightly more than 110,500 tons of copper in 1926, an increase of only about 1,000 tons over the production of 1925. The new construction program, increasing the present plant from a capacity of 120,000 tons to one of 187,500 tons of copper per annum, will be finished by April, 1927, but the rate of increase in production will depend entirely on market conditions.

No new electric shovels were installed at the mine, but further progress in electrification was made by the addition of six 70-ton electric locomotives. A third-rail system is being installed. The new main line connection on the south approaches and a few of the lower benches of the mine are being equipped for electric locomotive haulage. The system is in actual operation on tailings disposal, where it is working satisfactorily. The new installation will make a saving in mining costs. No changes were made in metallurgical practice. General conditions, as well as labor conditions, were good. The outlook for 1927 is viewed optimistically.

The new plant of the Andes Copper Mining Co. at Potrerillos is rapidly nearing completion and is expected to be placed in operation early in 1927. Its capacity will be 12,500 tons of ore per day, and when it reaches this, probably in the fall of 1927, production will be at the rate of 58,500 tons of copper per annum. Ground was broken late in 1926 for the construction of the oxide leaching plant, which will have a capacity of 7,500 tons of ore per day, or an annual production of 36,000 tons of copper. The combined annual production of both plants will be 94,500 tons of copper. The oxide ore plant will, however, not be completed and in operation until early in 1929. Oxidized ore will be crushed to ½ in. and treated with a sulphuric-acid leach, from which the copper will be electrolytically deposited. The plant design will follow the practice already established at plants now in operation.

A water-supply system was completed late in 1926. This will supply 22 sec.-ft. of water. A steam power plant was also constructed upon the coast and a double transmission line 80 miles in length was extended to the mine and ore-treatment plants. The power plant is of 30,000 kw. capacity, four turbo-generator units, each of 7,500 kw. capacity; being installed. It is expected that the first unit will be turned over early in 1927.

The mine has been developed and is ready to produce the expected tonnage. The principal adit, equipped for third-rail electric-locomotive traction, is 3.7 km. in length and is provided with 40-ton ore cars, hauled in 25-car trains. A mining method similar to that employed at Inspiration will be used.

Little interest is reported from the Braden Copper Co.; more copper was produced, but only minor improvements were made.

Bolivia

By C. Leonard Ball

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INDICATED production of the mines of Bolivia for 1926, based on the export statistics of the first eight months of the year, is slightly under that of 1925. A shortage of some 3,000 metric tons in fine tin should be somewhat offset by the production from the Guggenheim dredging operations at Aroifilla, near Potosi. The production of lead should be about 4,000 metric tons of metal under that of 1925, due principally to the exhaustion of old lead slag dumps. There is a slight increase in the production of silver, although the Huanchaca production has decreased.

Though the price of tin has been excellent, the Bolivian producers, especially the smaller ones, have been greatly handicapped by inability of the English tin smelters to handle the production, resulting in holding the local price for 60 per cent barrilla in the neighborhood of Bs. 40 (about $14 U. S. currency), with no market for "media barrilla" or 20 to 30 per cent tin middlings.

Undoubtedly, the future in tin production in Bolivia depends largely upon more exploration work in the cordillera region and the improvement of metallurgical processes for the handling of low-grade and complex ores. There was a marked improvement in the concentrating methods of the Llallagua company, and important changes are planned at Araca.

Theodore Holt and Victor Hampton have done some very interesting research work in their Oruro laboratory on complex tin ores and middling concentrates, having for its objective a reduction of oxides to metallics and leaching with weak acid or acid-brine solutions. They have opened up a field for experimentation, as the economic production of metallic tin in Bolivia by hydrometallurgical methods would place Bolivia in an enviable position in the tin market.

With the exception of the dredging operations at Aroifilla, there has been no new operation of importance. The disadvantageous position of Bolivia in the tin market has not been encouraging to prospectors, although there are extensive areas along the contact between the granite and the slate and quartzite in the cordillera region which merit thorough prospecting.

Mining in Southern Africa

Increase in Gold Production—More Diamonds from Alluvials

By Owen Letcher

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THE YEAR 1926 witnessed a large expansion of mining operations in southern Africa, and in most branches of the mineral industry there has been a material increase in production. Estimates based on returns for the first nine months are that the value of the output of metals, minerals, and mineral products of the Union of South Africa will be about £57,372,000, compared with £54,478,000 for 1925. For the completed three-quarters of 1926 production in the four provinces of the Union is as given in the accompanying table.

South African Mineral Production for the First Nine Months of 1926

		Value in £
Gold	430,638 oz.	31,563,346
Silver	734,459 oz.	98,535
Osmiridium	4,806 oz.	79,571
Platinum	1,641 oz.	31,246
Diamonds	2,213,068 metric carats	7,447,628
Coal	10,063,630 tons	2,968,902
Copper ore and concentrates	6,991 tons	359,309
Tin concentrates and metallic	1,380 tons	238,193
Other minerals	.....	242,451

At the moment of writing it appears to be fairly certain that the Witwatersrand gold fields will register another record, with a production of approximately 9,620,000 fine oz., compared with 9,347,000 oz. in 1925. In September, the Witwatersrand celebrated its fortieth birthday in a spirit of carnival, and it is not unfitting that during this year the auriferous conglomerates of the Witwatersrand system, which have to date produced a total over two hundred million fine ounces of gold and have proved themselves the most remarkable gold area ever discovered, should add still another record to their laurels.

During 1926 steady progress, somewhat impeded during the first few months by native labor shortage, was made in further translation into actual practice of principles established by the Rock Drills' Committee some years ago. Efficiency further improved and there was a consequent small but important reduction in working expenses. A feature of practice on the Rand during 1926 was the tendency to revert to cleaner mining as enunciated years ago, but which was subsequently submerged by the big mill policy. This narrow stoping method has been applied with particular success at the Sub-Nigel, a mine which, by virtue of Reef conditions obtaining there, is especially suited to carrying stopes as narrow as 18 inches and resuing. The company recently acquired over 2,000 claims from the government, and through excellent development secured progressive improvement in profits. The Sub-Nigel may aptly be termed "the mine of the year" on the Rand.

During the last few months one or two of the older properties which have made the Rand famous, such as the Robinson and the New Unified, ceased production on account of the exhaustion of their ore contents, and within the next year or so other properties, such as the Ferreira Deep and Aurora West, will likewise suspend. To counteract this, an important program is under way by the West Rand Consolidated Mines, which has recently announced that the government has agreed to the opening up of the Geduld East lease area through the present workings in the Geduld mine. A company with a capital of £350,000 is now being formed for the purpose.

After gold, diamonds, as in former years, occupy the major position in the Union's mineral output. The diamond trade has been active throughout the year, and recently concluded contracts with the Buying and Selling Syndicate and the inter-producers' agreement appear to be working well. The event of the year was the vast increase in output from alluvial areas of the western Transvaal, particularly in the Lichtenburg district. A huge town, with a population of about 80,000 persons, has sprung up in this area, during the last few months. It is confidently expected that the output from these fields during the next few years will amount in value to some millions of pounds and may greatly affect the Syndicate's operations and the "Big Four" of the South African diamond producers.

Another feature of interest in connection with diamond mining was the discovery of diamonds on the coast of Namaqualand under conditions similar to those obtaining in Southwest Africa.

In coal mining, the year has been barren of interest—unless account is taken of the fire that occurred at the Witbank Collieries and the disaster at the Durban Navigation Collieries, Dannhauser, Natal. The latter was the most calamitous affair that has occurred in the annals of coal mining in South Africa. The protracted coal strike in England favorably influenced the operations of South African collieries. Substantial quantities of coal were exported from both the Transvaal and Natal coal mines to Europe and to other countries which normally secure their supplies in Europe.

The embryonic platinum industry developed favorably during 1926. Discoveries of importance were made in the Rustenberg district of the Transvaal, and the more important of these were acquired by the Potgietersrust Platinum Mines, Ltd., a company headed by Solly Joel, which appears determined to obtain control of the principal sources of platinum in South Africa.

In the Union's Mandatory Annexe, South West Africa, there has been a considerable revival of mining activities. The new plant of the Consolidated Diamond Mines of South West Africa, the most modern and effective equipment of its kind in South Africa, is now coming into operation.

The prevailing high price for tin induced several of the cassiterite producers on the Erongo tin belt to expedite development and to install pilot crushing and concentration plants. Boring for oil is in progress in the Gibeon district.

The mining position and outlook in Rhodesia may be said to be generally satisfactory. In Southern Rhodesia the gold-mining industry is a little more than holding its own and here and there developments are taking place which augur well for early expansion. The base-metal industry is in a flourishing condition, and there is no reasonable doubt that a much larger production of chrome and asbestos and other metals and minerals will be recorded in the near future. Steady development and constructional work that has been in progress in Northern Rhodesia for the last three or four years will soon begin to bear fruit, and it is certain that Rhodesia beyond the Zambesi is destined to become an important copper-, zinc-, and lead-producing country. The development of copper properties (of which the Bwana M'Kubwa has begun production) and the opening up of the Rhodesian Broken Hill lead, zinc and vanadium mines have been the chief features.

In Southern Rhodesia the outstanding events of 1926 in mining were satisfactory developments at the Cam and Motor, Sherwood Starr, Wanderer, and Gaika gold mines, and the steady progress of the chrome, iron ore, and asbestos industries.

In Portuguese East Africa the Inyaminga Petroleum, Ltd., is engaged in boring operations close to the line of the Trans-Zambesia Railway. The prospects of this company are speculative but attractive. Copper production of the Union Minière du Haut-Katanga in the Southern Congo was in 1926 materially below that for 1925, when an output of 90,000 tons was made. This decrease results from the diversion of a large percentage of the labor force to constructional work. The company is now engaged on the erection of two and perhaps more large reverberatory furnaces and the first unit of a leaching plant at Panda. When these two plants are in operation, Union Minière's output will be augmented by 60,000 tons of copper per annum.

A new washing plant has been erected at the Ruashi mine. Development continues to yield satisfactory disclosures, particularly at the Kipushi (or Prince Leopold) mine, on the Congo-Rhodesian border. Satisfactory progress has been made with the Bas Congo Railway, and the Lobito Bay line has now reached a point less than 300 miles from the Congo border.

In Tanganyika Territory the outstanding event of 1926 was the exploitation of the Tanganyika Diamonds property under the aegis of some of the big mining houses of Johannesburg. There has of late been considerable litigation concerning this property, the true value of which, it appears, has yet to be determined.

Belgian Congo's Production Normal

Copper Decreases—Diamonds, Gold, and Tin Increase

By Sydney H. Ball

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ALTHOUGH the mineral production of the Congo in 1926 was slightly less than in 1925, the mining industry enjoyed a prosperous year and by adding to and by perfecting its plants put itself in a position to increase its mineral output in future years. A slight decrease in the copper output was in part offset by increases in diamond, gold, and tin production. The colony holds the following positions as a producer of the world's mineral products: first in the production of radium and presumably in that of cobalt; second in diamonds, and third in copper. In addition it produces considerable gold and some tin ore.

The diversity of the colony's wealth is indicated by a souvenir given the Duke of Brabant, heir to the Belgian throne, upon his return from the Congo; among the materials used were gold and silver from the Kilo-Moto mines. gold from the Aruwimi-Ituri and Tele mines, diamonds from the Kasai mines, sapphires from eastern Congo, and bronze made from Katanga copper and tin.

Mining is the backbone of the colony's prosperity—the industry is the largest employer of labor, both white and black; it furnishes railroads and other transportation lines with the major portion of their freight; in 1925 mineral exports were valued at 820,000,000 francs, or 73 per cent of the total, and in 1926 revenue of the colony from the mining industry is expected to be 260,000,000 francs.

A normal amount of railroad building was done and several minor lines were completed, but the big projects under way, the Lower Congo-Katanga Railroad, the Benguela Railroad, and the reconstructed Lower Congo Railroad still require from two to four years for completion. Motor roads were improved and extended; telephone mileage and wireless installation were increased. Commercial airplane routes between Boma and Leopoldville and Leopoldville and the Katanga were established. It may be added that Belgian military aviators made a flight from Brussels to Leopoldville and return between March 9 and April 12, 1926.

The Union Minière du Haut-Katanga produced in 1926 about 82,000 long tons of copper, as opposed to 90,104.3 long tons in 1925. The decrease was due to labor shortage, in part explained by the Rhodesian mining and agricultural boom which drew back to their homeland some Rhodesian natives who at the end of 1925 made up 37 per cent of the Katanga black labor force. Under the circumstances the company wisely decided to curtail production rather than slow down its construction program. Labor-saving machinery is being introduced and more Congo natives are being recruited. The company to date has produced some 530,000 long tons of copper; of which almost 50 per

cent has been produced in the last three years.

In November the company issued a further 100,000 "privileged" shares (par 500 francs) at 2,580 francs, netting the company over $7,000,000 for construction. In February an American subsidiary, "African Metals Corporation," was formed to sell the company's products within and otherwise to represent it in America. The Union Minière is a member of the Copper Exporters, Inc., and the foreign office of the association is in Brussels. In June the Union Minière bought a substantial block of the common stock of the Nichols Copper Co. and entered into a long-term contract with that company to refine part of its metal. It exported to the United States, in the first half of 1926, 50,002,000 lb. of copper.

At the 1925 year-end, ore reserves were 76,892,943 tons containing 5,285,640 tons of copper, or an average of 6.87 per cent. In 1925, 1,388,453 tons of copper ore was mined in addition to 203,926 tons of limestone and 87,258 tons of iron ore. Eighty per cent of the ore was treated at the Panda mill, which produced a concentrate with 24.12 per cent copper. The pilot flotation plant for the treatment of tailings and low-grade ore functioned so satisfactorily that a large unit is to be installed. Various washing plants at the mines operated normally. The blast furnaces produced 81,081.7 tons of bar copper; the experimental reverberatory furnace 7,370.5 tons; the experimental electric furnace 290 tons, and the pilot leaching plant at Panda 1,362 tons.

Important plant enlargements and additions contemplated have been already described. These consist of a reverberatory furnace plant, annual capacity 30,000 to 40,000 tons, and to be completed in 1927; electrolytic leaching plant, annual capacity 30,000 tons, to be completed late in 1928, and a flotation plant. There is additional construction, including hydro-electric plants, pulverized coal plant, repair shops, brick making yards, sulphuric acid plant, and other accessories. In 1926, the following mines were operated: Star, Ruashi, Likasi, Chituri, Kambove, and Kalabi, and Prince Leopold (formerly Kipushi), Lukuni, and Luushia-Extension were prepared for production in the near future.

Locally the Katanga oxidized copper ores, particularly those of the Ruashi mine, contain a high cobalt content. Such ore is treated in one blast furnace at Lumbumbashi and the slag therefrom is treated in three electric furnaces at Panda, producing a copper-cobalt-iron alloy. This alloy is shipped to Oolen, in Belgium, where cobalt metal and salts are produced. A total of 683.5 tons of alloy was made at Panda in 1925.

The present reported refining capacity of Oolen is 750 tons yearly. This plant, belonging to the Société Générale Metallurgique de Hoboken, started refining late in 1925 and has been in regular operation since the beginning of 1926. In February, 1926, the plant was said to be producing one ton of cobalt daily. Cobalt and its products are now being marketed in America and favorable contracts have been made elsewhere. This metal company is also erecting a plant to refine 65,000 tons of Katanga copper electrolytically per annum. In 1925 the Oolen radium refining plant worked only part time, the greater portion of the 20 grams sold being from stock. An outlet for the uranium byproduct is being sought by the company. This relatively cheap African radium is said to be seriously hurting the market for mesothorium.

The Union Minière's Busanga mine in 1925 produced 854 tons of tin ore, which is refined by The Metallurgique company at Hoboken. The 1926 rate of production was probably somewhat higher.

Covering 1925 operations, dividends of 175 francs per capital and dividend shares and 30 francs on the preference shares were declared.

The Geomines (Compagnie Géologique et Minière des Ingénieurs, at Industriels Belges) has coal fields at Grenerville, in the eastern part of the colony; important tin placers in northern Katanga, and interests in the Luena coal field and the Lueta Diamond Co. It also has two principal tin mines, Manono and Kitololo, the former being the more actively exploited. It is connected with the Lualaba, a navigable river, by a narrow-gage railroad. The tin ore production of the company's placers for 1926 will presumably approximate 740 tons. At the end of 1925 the reserves as reported were 25,000 tons of cassiterite. The progress of this company, which employs at its tin mines about 800 and at its coal mine from 150 to 200 blacks, is retarded by labor shortage. In 1925 about 750 tons of coal per month were mined. In the year ending June 30, 1926, it made 10,434,632.50 francs as compared to 6,637,463 francs the year before. The Simkat also has tin placers in northern Katanga, but its 1926 production was presumably not over 250 tons of cassiterite.

Charbonnages de la Luena (capital, 20,000,000 francs) has recently reported discoveries of better grade coal at shallow depths in its coal field in northern Katanga. Mine fires restricted its 1925 production to only 56,000 tons. It has a central hoisting shaft, a washery, and an electric-power plant. Its product is in demand by the Union Minière and the local railroad, so that an increased production is to be expected. The Union Minière expects to powder the coal and generate power with it, thus setting free for other work 4,000 natives now cutting wood for steam boilers. There are two small portland cement plants in the colony, one in the lower Congo and the other in the Katanga.

The gold production of the colony is gradually increasing: in 1926 it approximated 4,250 kilos (136,637 oz.), worth some $2,733,000.

It is unusual to find state-operated mines which are profitable: such are the Kilo-Moto gold mines, in the northeast part of the Belgian Congo. Exploitation at Kilo began in 1905 and at Moto in 1911, and since then to the end of 1926 41,675.272 kilos (1,369,860 oz. worth some $27,500,000) was produced. The major portion has come from placers, but in 1920 veins began to be exploited, and up to Dec. 31, 1925, about 132,000 tons has been treated, a recovery of about 1,370 kilos of gold, or, say $6.25 per short ton, having been made. At present amalgamation is the treatment, but in 1927 a cyanide plant will be completed and in operation. The 1925 production of the two mines was 3,419.995 kilos (value about $2,199,000), of which Kilo produced 60 per cent and Moto 40 per cent. The 1926 production was about 3,640 kilos (116,880 oz.), worth about $2,337,600. An increased production is to be expected in future years, the reserves now being 50,000 kilos of gold (1,607,500 oz.) One hundred and eighty-five whites and 19,000 blacks are employed. The labor problem is difficult, but the sane and logical labor policy of the managing committee will doubtless solve it.

In March colonial 6 per cent bonds to the value of 200,000,000 francs (eventual total issue 700,000,000 francs) were floated, which, in addition to the normal interest, are to participate in part of the earnings of these gold mines. The profits for the six years 1920-25 were 132,000,000 francs. Gravel washed in 1920 contained an average of 2.87 gm. per cubic meter ($1.41 per cubic yard), but this has gradually fallen until the average in 1924 was 1.7 gm. per cubic meter ($0.84 per cubic yard). The gold is sold in London, except for some 400 kilos (12,860 oz.) yearly reserved for the use of Belgian goldsmiths.

The Aruwimi-Ituri and the Forminière companies (operated by the Tele company), are producing alluvial gold in this general part of the Belgian Congo. The approximate production for 1926 of each was about 100 kilos (say 3,200 oz.) These companies produce as a byproduct a few diamonds. In addition several other companies have taken out concessions or are prospecting in that region.

The Compagnie Minière des Grands Lacs Africains is working a couple of placers in eastern Belgian Congo. In 1924 its production was 42 kilos (1,350 oz.); in 1925, 232 kilos (7,459 oz.), and in the first six months of 1926, 183 kilos (5,883 oz.), suggesting a production of 400 kilos (12,860 oz.) for 1926. At the end of 1925 it had blocked out 3,875 kilos of gold (124,581 oz.) In addition to gold the company has found sapphires, platinum, and tin. In 1925 it employed 27 white men and 1,150 blacks.

The diamond-mining companies in the Kasai region enjoyed a prosperous year in 1926 and somewhat exceeded the 1925 production. The operating companies in the Congo are the Forminière, Kasai, Beceka, and Luebo and the Diamang company, in Angola. All paid satisfactory dividends in 1925. These companies employ some 340 whites and 27,000 blacks. A new diamond-mining company, the Lueta, which promises to be a small producer, was formed during the year. Several other companies and groups are prospecting or are later to prospect in the region.

Some of the kimberlite pipes in the Katanga were prospected in 1925 by the Kundelungu-Lualaba Exploitation Committee. Although diamonds were recovered, it was decided that the pipes are non-commercial.

Australasian Mining Progress

Alluvial Tin Properties Attract Attention—Broken Hill Maintains Tonnage

By Peter G. Tait
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WESTERN AUSTRALIA still maintains its position as the producer of approximately 70 per cent of the Australian gold output; but, whereas in 1915 the total production was nearly 2,000,000 oz., in 1924 the total was 678,-062, and in 1925 it had further dwindled to 564,849 oz. At this date it is impossible to estimate with accuracy what the 1926 production will be, but the figures available suggest that a still lower record will be touched.

The Commonwealth Government has asked the migration and development commission, of which H. W. Gepp, formerly general manager of the Electrolytic Zinc Co., is the chairman, to look into the position of the industry, and a committee of mining men has been appointed to undertake the investigation. They have started at Kalgoorlie and may also visit other fields. Today, however, for all practical purposes Kalgoorlie is the pivotal point. The question is an economic one. Will it pay to reorganize mining and treatment methods?

The discovery of a rich alluvial field would do much to rehabilitate gold mining. There are possibilities in Central Australia, and the appointment of J. Horsburgh, formerly assistant general manager of Mount Morgan, as chairman of the Northern Australian Commission, will insure a sympathetic understanding of the claims of the mining industry, the development of which would do more to attract population to that sparsely peopled area than any other plan. The recent find in ex-German New Guinea illustrates the lure of gold, even though the expense in getting there is beyond the means of the real prospector type of miner. In the last few months over £60,000 worth of gold has been shipped to Australia, and regular shipments seem likely. Most of it has been produced by individual prospectors. One Australian company is shipping a small sluicing plant to the field. The Glenelg Hills find, to the south of Southern Cross, W. A., is another instance of the "magnetism" of gold, but time alone will tell whether it will live up to anticipations. A parcel of 12½ tons of ore recently treated at the Coolgardie state battery returned an average of 7½ oz. per ton.

The statistical position in New Zealand is similar to that of Australia. Whereas in 1924, gold production was 124,976 oz., in 1925 it had receded to 111,061 oz., and 1926 will probably record a still lower production. The famous Waihi field experienced a further restriction of operations by the arrangement between Waihi and Waihi Grand Junction, whereby the former will work the mine of the latter company, treat the ore won, and share the profit. There has been a distinct revival on the Thames field, a number of companies being formed to work promising areas. The Thames was a remarkably rich field in early days, and the unearthing of one really payable reef would stimulate prospecting and development.

The Kawarau River scheme in Central Otago did not reach the production stage in 1926, owing to delay in completing erection of the dam. The winter of 1927 should definitely decide whether the bed of the river is as rich as optimistic promoters claim. Of the mines in the Reefton district controlled by the Consolidated Goldfields of New Zealand —Blackwater, Progress & Wealth of Nations—the only one operating on a normal scale at present is the Blackwater. The American company, Rimu Gold Dredging Co., operating at Rimu Flat, near Hokitika, continues to obtain satisfactory returns from its dredge.

Silver-Lead—Broken Hill maintains its position as one of the world's leading mining fields. The large smelters at Port Pirie, South Australia, and the electrolytic zinc works at Risdon, Tasmania, are offshoots of these successful mines. Several attempts are being made by sanguine promoters to locate extensions of the Broken Hill lode, but up to the present, seven mines, Proprietary, North, South, Central, Zinc Corporation, Junction North, and Block 14, are the only properties of live interest. The quantity of ore treated in 1925—1,265,977 tons—was the highest for the last ten years, and the 1926 production will reach about the same figure.

In Western Australia the Northampton mines have closed down owing to financial difficulties. The Surprise, at Galena, has also closed, but the Two Boys, in the same district, promises well.

In Tasmania, the North Mount Farrell, Magnet, and Round Hill are the principal producers, but a new property, the Comet South, at Zeehan, is being equipped and will enter the list of producers in 1926. Other mines in the Zeehan field are attracting attention of investors. Most of the Tasmanian silver-lead ore is shipped abroad. The Electrolytic Zinc Co. is engaged on an active development policy at its Hercules, Mount Read, and Roseberry mines. Huge tonnages of ore are known to exist, and this belt of country will probably be the source of supply for the company when the Broken Hill output diminishes. The company's flotation mill at Zeehan has a capacity of 1,000 tons of crude ore per week. Concentrates are roasted locally and shipped to Risdon.

Mount Isa, in Queensland, is still engaged on development. Slow progress is being made in the construction of the railway by the government, and it will be several years before the productive stage is reached.

Tin—There are signs of a revival in tin mining, both alluvial and lode. High prices for the metal have stimulated prospecting. Several strong syndicates are testing options in Tasmania, and if a satisfactory dredging property can be found it is likely that bucket dredging, which was a dismal failure when tried nearly twenty years ago, will be reintroduced. This time they will have the experience gained in Malaya to guide them. A group of lode mines at Renison Bell, the Boulder and Dreadnought, has been taken up by a syndicate and it is understood that prospecting work carried out justifies the erection of a large plant. The Federation mine, at Heemskirk, which was developed by an Australian company, has been taken over by London capitalists, who will provide the money necessary to erect a 60-head mill. Production should begin next year. The Mount Bischoff (lode) and Briseis and Pioneer (alluvial) mines maintain regular production, and are the mainstay of the Tasmanian tin industry.

In New South Wales the Tingha Hydraulic, a London company operating in the New England district, has completed its reservoirs and sluiceways, but tin winning has been delayed longer than anticipated. There is a large number of sluicing plants at work in the district, but for the most part operations are on a more restricted scale than in former years. The principal lode-tin mines of New South Wales are the Carpathia and Wild Cherry, at Ardlethan, but several new mines round Emmaville are being opened up.

The principal Queensland tin-mining centers are Stanthorpe in the south, principally alluvial, and Herberton, Ewan, and Irvinebank in the north. The production comes principally from small properties. The Ewan lode mines, of which the Sardine is the principal one, are carrying out development in the hope of finding larger oreshoots. Some good returns were obtained from the Sardine during the year. A serious shortage of rain affected most of the tin producers in Queensland and New South Wales during 1926.

Copper—Mount Lyell pursues the even tenor of its way, maintaining a production of about 7,000 tons of blister copper per annum. Mount Morgan is still engaged in the reorganization of plant preparatory to reverberatory smelting. If experimental work be satisfactory it may mean a resumption of operations on a fair scale.

The Cloncurry field is quiet. Hampden Cloncurry mines were put up for sale during the year. The Mount Elliott is erecting the first unit of the Mackay process, which is to have a capacity of fifty tons of ore daily. "Gougers" are doing fairly well extracting ore from old mines, but these men seldom do anything in the way of real development. The Chillagoe state mines and smelters present a serious problem for the government. On the one hand is the need for local works to treat ore from numerous small mines if population is to be retained; on the other is the fact that it is impossible to make the works pay. Periodical smelting campaigns are undertaken when supplies of ore are available. It seems unlikely that the government will continue to operate the mines on its own account, because of the heavy losses incurred at the field and the generally hard-up condition of the state treasury.

Mining in Europe

By W. A. Doman

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LACK OF CAPITAL interfered with mining progress in Europe during 1926. Much has been done in exploitation, but results have been poor. At least, production has not greatly increased in any direction. Attention has been paid to aluminium, copper, zinc, nickel, and, to a minor extent, tin, though no material increase can be reported. As regards nickel, the Greek Government has conceded to an English group the exploitation of the deposits at Lokris, and a company has been formed with a capital of £770,000. The agreement provides for the production of 500 tons of nickel per annum, the Greek Government having the right to buy at prices current in London. The company undertakes to be in full operation either at the end of 1928 or at the beginning of 1929.

The search for tin has led to the registration of the Gondor Tin Mines to work a concession in Portugal, in the district of Biano do Castelo. The Tamega Tin Co., which also operates in Portugal, continues to make good progress. Both in Spain and Portugal the value of mineral deposits is recognized; the drawback again is lack of capital. The Spanish Government's taxation measures are severe, preventing influx of money that otherwise would take place. In Portugal the copper companies do not receive the generous treatment to which they are entitled, and the Mason & Barry, which has worked for many years, has had to complain. In a sense it is comprehensible that wealth taken out of the ground should, being irreplaceable, make some contribution toward the state's finances; but it appears that though the Mason & Barry has increased its shipments of ore, taxation is more onerous, and the imposition of a new import tax more than wiped out the benefit obtained from a reduction in wages. Generally speaking, the position of the Mason & Barry is representative of that of other copper companies in the peninsula — Huelva, Tharsis, Rio Tinto, and others.

Whether Dome Mining is to turn out an absolute disappointment is not yet clear. Little has been heard since the blare of trumpets with which it was brought into existence. Curiously enough, the company has always been subject to rumor, and shareholders are wondering what they will eventually get for their money. First it was said that the dredge had sunk, then that it had been located on ground belonging to another party and had to be removed. In any case the company makes no great addition to the gold output of the world.

Quite recently there was a discovery in Yugoslavia, near Chtip and Radovitch, of some fine deposits of copper and lead. These have to be further tested. The Rumanian Government, which has been principally concerned with oil, has taken in hand the reorganization of old gold mines, and has, it is said, arranged with an English syndicate to work them as a commercial undertaking.

Important deposits of lead have been discovered in Bulgaria, and American engineers have examined them with a view to exploitation and to prospect for other deposits. The immediate trouble here is that the lead deposit is in a region difficult of access, the mountains of Rhodope, and the extraction of the metal demands a considerable amount of capital for the construction of roads and railways giving access to the mines. The Bulgarian Government is ready to grant concessions to foreigners. The Plakalnitza Co., which works lead and copper deposits, has acquired options over additional properties in Bulgaria, in the neighborhood of Boussintzi, where copper and lead ores have been discovered.

When one turns to Italy, the same drawback is noticeable—so little money available to open up the mines. The bulk of the mining concessions do not give the return that is expected, and, as said, this is attributed to the need of additional capital and to the lack of initiative on the part of concessionaires. The Pechiney Co. is going to install near Naples a factory for the production of aluminum.

In England tin mining in Cornwall has received a fillip from the high price of the metal, though full advantage cannot be taken of it, on account of the excessive cost of coal. Exploitation has been active in various directions, and one or two companies have received financial assistance under the Trades Facilities Act. Though various new lodes, some of them of importance, have been discovered, little addition has been made to metal output, and further capital is required. The working of stream tin has proceeded on an active scale, for although the quantity of metal recovered is small, the cost of winning it is also small. During the year some of the old lead mines of Derbyshire were reopened and application was also made for further claims. As, however, the price of lead has declined, the working can scarcely have been profitable. No results have been announced. A gold mine and a silver-lead property have been worked in North Wales. A small amount of capital has been put into them, but nothing definite has been announced.

Russia and Siberia

By W. A. Doman

APART from Lena Goldfields little of interest has taken place in Siberian gold mining. This is in some degree due to the difficulty of obtaining funds and partly, so far as Siberia is concerned, to rigorous terms demanded by the Soviet authorities when granting concessions. There can be little doubt that money would be forthcoming if it were possible to work at a profit after satisfying the conditions, but mining houses do not care to enter into obligations with the Soviet and with the public that cannot be fulfilled. Rich mineral deposits are known to exist, and some have been examined, particularly in the Amur region. Labor, transportation, and enormous capital outlay are deterrents. One well-known mining engineer reported to his principals that the values were there right enough, but that to build towns, settle labor, and construct roads rendered the proposition prohibitive. Besides, there was the example of Lena Goldfields. This is probably one of the richest gold deposits, and considerably over £1,000,000 worth of gold was extracted in 1926, but shareholders do not seem to be much nearer any reward for their outlay. At the end of 1925 work was resumed on the concession, and monthly returns have been reported. From one standpoint they make the mouth water; from another they are disappointing. The fact is the bulk of the gold has to be sold to the Soviet authorities for depreciated about 50 per cent, and chervonetsi, and as the chervonetz has stores, machinery, and other commodities have advanced considerably in price, there is little left in the way of profit. When the tide will turn no one can say, and meanwhile financiers hold aloof, though other concessions are available. The Lena also has concessions in the Urals, but only one output of pig iron, steel, and wire has been announced. This is discouraging from the capitalist's point of view.

The Russo Asiatic Corporation has made no progress toward regaining its properties. Negotiations have been in progress, and I believe still are, but from what I can gather there is not likely to be any change. Conditions are too onerous. It has been suggested that rather than comply with them the present owners would prefer to get some compensation and clear out. The same thing was said of the Lena Goldfields, and, though it is impossible to check such rumors, the sale of shares through a pool might give the necessary compensation.

The Russian Government has been making a geological survey of the mineral resources of territory in the Caucasus, Ural, Ukraine, Donetz, Crimea, and Altai. An important gold deposit has been discovered in the region of Aldan, Yakutsk.

One of the most interesting features of 1926 was the working of the manganese concession granted by the Soviet authorities to the Harriman Syndicate. The great stumbling block was a condition laid down by the Soviet. This condition was that while the concessionaires were granted the right to dissolve the contract if it were found to be disadvantageous, they were still required to pay $4,000,000 for construction of railways and plant in the mining region. Recent reports that Harriman had sold his concession to a European cartel have been denied.

Mines in the Far East

By W. A. Doman

UNQUESTIONABLY most of the activity, the excitement, and the promotions of 1926, so far as regards the Far East—and ignoring Siberia—have been in tin mining; not alone in Malaya, but also in the French territory of Indo-China. In the former, more capital has been put into the country and more companies have been

floated than in previous years, the stimulus being the demand for tin and the scarcity of known deposits elsewhere in the world that can be worked profitably. In Lower Burma the metal has been mined for centuries, and its occurrence is still being proved over wide areas, Tavoy and Mergui being mainly favored. Although several of the older companies have extended their areas and increased their plant facilities, the larger number of companies now in existence cannot be said to have increased the metal output substantially. In one or two isolated cases the best portions of ground have been worked to take advantage of the current price of tin, though other companies have pursued an opposite policy in view of their limited mining areas. It is interesting to note that a rubber company has sold some of its land planted with rubber to another company which will uproot the trees and dredge for tin.

The method of winning tin is either by hydraulicking or by dredging. It would appear from reports made in connection with recent flotations that in the future dredging will be the principal working method. Dredges are now being equipped with jigs and classifiers, and jigs at present in use are being modified. Suction dredges have not proved a success, and in some cases bucket dredges have replaced them. Electric power is being used, and the Perak Hydro-Electric Power Co. is to supply the Malaya tin industry with hydro-electric power from the Perak River to the extent of about 97,000,000 units per annum. There should be a great saving in labor, a necessity owing to the competition of the rubber estates for native workers. In Malaya activity has been great, and during 1926 to Oct. 1 export of tin concentrates had reached 38,080 tons, compared with 38,858 tons for the same nine months of 1925. The total for 1925 was 45,925 tons.

Quite apart from Malaya and Burma the French have made various discoveries of tin and wolfram in Indo-China. One property has a deposit yielding from 1.5 to 2.2 per cent of tin, and this is claimed to be superior to deposits in the Federated Malay States. One company alone in Chodieu is expected to produce in 1927 a total of 35,000 tons of mineral worked up to a 60 per cent concentrate. Another company has produced 200 tons of tin already, and it is said that the Société d'Études et d'Explorations Minières de l'Indochine can become by degrees the principal tin producer in the world. Yet another property, at Tinh-Tuc, has already extracted 350 tons of metals, the ground containing a high percentage of tin. At a place called Bannongtsen, pits only 20 ft. deep have proved a rich bed of tin, samples showing from 1.26 per cent to 6.81 per cent. The reserves are estimated at 200,000 tons of material, assuring a life of about fifteen years.

A German group has obtained from the Governor of the province of Kwangsi, in China, a concession for twenty-five years to search for and work antimony and lead deposits. A royalty is payable and 25 per cent of the net profit.

In Northern Korea, the Great Nurupi mine, belonging to the Chosen Syndicate, has opened up fairly well; a new oreshoot has recently been discovered at the western end of No. 8 level, in a part of the property looked upon hitherto as unprofitable. The average grade of ore reserves is rather under 9 dwt. and the average width of the oreshoots is slightly less than 5 ft. Little real work has been done on the northern concession, where large cavings have taken place, this area being left until the Great Nurupi is on a good profit-earning basis. Floods have prevented full-scale working in the south, and for a similar reason the Oriental Consolidated, owning the adjacent concession, has had to check operations in the lower levels of the mine.

Early in 1926 the fire area in the Burma Corporation mine was effectually sealed, and normal operations are prevailing, an increased labor force being employed. In July an important strike was made in the No. 8, or lowest level, the Chinaman orebody being intersected 62½ ft. wide, averaging 23.8 oz. silver, 34.4 per cent lead, and 16.4 per cent zinc. Later, unprecedented rains interrupted traffic between the mine at Bawdwin and the treatment plants at Namtu. Landslips occurred on the Burma railways, and ore tonnage treated was temporarily reduced. To the end of October, the latest date for which figures are available, the Burma Corporation has produced from its refinery this year 43,998 tons of lead, 4,300,972 oz. of silver, and 9,631 tons of copper matte.

Mines in India

By W. A. Doman

NOTHING EXCITING in Indian mining occurred during 1926. The gold mines of the Kolar field continued their operations, though production has fallen off to a certain extent. To the end of October, the latest date available, the output was 317,118 oz., compared with 326,109 oz. for the corresponding period of 1925. For the whole of 1925 the gold mines produced 391,429 oz., so that, taking an average for the final two months, the 1926 output would appear to be 20,000 oz. lower. The Champion Reef Co. has not been free from rockbursts, the worst having taken place at the beginning of October in the No. 40 level, when three men were killed, one man was injured, and five workers were reported as missing. As usual there was no warning, and many miners had miraculous escapes. As a greater depth is attained the values become rather less, and though the Kolar mines are well managed, costs cannot be lowered to any extent. The gold field of Mysore, which owned the original areas, went into liquidation, but as a firm offered to buy the shares at 1s. 6d. each, application is to be made to the court to rescind the liquidation resolutions.

Outside the Kolar field the North Anantapur has been developing its new Gooty property, some distance to the north of Anantapur, where fair values have been encountered. The quartz orebodies are lenticular, and pinch and make so frequently that it is not easy to calculate tonnage. Initial difficulties were also experienced in connection with reduction operations, but a better extraction is expected soon.

The Indian Copper Corporation has been actively developing its Mosaboni mine. In places the lode attains a width of about 7½ ft. The estimated reserves of payable copper ore opened up to date are 545,142 tons, and the average content seems to be around 4 per cent.

The Central Provinces Manganese Ore Co. has maintained its position. Recently the company completed negotiations with four of the principal makers of ferromanganese in the United Kingdom for their supply of manganese ore and for the manufacture and sale of ferromanganese.

A company called the United Kingdom Ferro-Manganese Co. has been registered, with a nominal capital of £350,000. Its objects are to enter into agreements with the Central Provinces Manganese Ore Co. and with the Darwin and Mostyn Iron Co., Dorman Long & Co., United Steel Companies, and Wigan Coal & Iron Co., and to manufacture and deal in manganese ore, ferromanganese, metals, and minerals of various kinds.

Japan and Manchuria

By Hironao Mishihara

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MINING in Japan and Manchuria in 1926 appears to have continued quiet and insignificant, as in 1925. Data for 1926 are available only up to July. The record of the six months shows the following production:

Gold, oz.	150,812
Silver, oz.	2,343,530
Copper, lb.	6,802,761
Iron, tons (metric)	40,608
Sulphur, tons (metric)	20,698

The foregoing table shows a small increase as compared with corresponding figures for 1925—4 per cent on gold, 10 per cent on silver, 1 per cent on copper, 37 per cent on iron, and 8 per cent on sulphur. There was a small decrease in coal production.

The Taio gold mine, a quartz-calcite vein deposit and an independent producer, has led the others and maintained monthly average production of over 3,500 oz. for twelve months. In Hokkaido, the Konomai gold mine, since its reopening has maintained third place, with a monthly production of 1,760 oz. The old Kushikino gold mine, in Kiushu, another quartz-calcite vein deposit, has steadily produced and keeps its position as the second largest producer.

In Manchuria neither the much-talked-of shale-oil plant at the Fushun colliery has as yet been started on a commercial scale nor has the activity at Anshan Iron Works, where a "new method of ore treatment" is being tried, attained actual production. Vast quantities of magnesite of high quality and associated talc deposits have been unable to find a market outside Manchuria, and nothing has as yet been done with a lithographic limestone which was discovered recently.

CURRENT PROBLEMS

TAXATION *of Mines Involves Few Changes*

Discovery Clause Revised—Repeal of Capital-Stock Tax

By Henry B. Fernald
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IN FEDERAL taxation the outstanding feature of 1926 was the passage of the Revenue Act, in a fairly non-partisan spirit, definitely recognizing taxation as a question of revenue and expenditure rather than considering it as a punitive means of correcting real or fancied abuses. Not less creditable to Congress is its recognition that the tax system and administration is a problem so complicated that solution will not be found in ordinary legislative routine; hence the law creates a Joint Congressional Committee of the Senate and the House, with practically two years in which to study the operation and effects of the federal internal-revenue tax system and administration and to report thereon.

The act was drafted and passed on the basis that burdensome tax rates were not desirable either from a revenue or an administrative standpoint. Results have shown that reduction in rates does not necessarily mean reduction in revenue. The only change specifically relating to mines was the revision of the discovery clause to give a more definite statement in the act of what was to be considered a discovery, but this was not intended to be anything more than a writing into the act itself of what was the department's interpretation of the prior act.

For depletion of oil and gas wells a distinct change was made to allow depletion on a basis of 27½ per cent of the gross income from the property during the taxable year, although still continuing the limitation of depletion to 50 per cent of the net income, except that depletion is still allowable on the basis of the cost of the March 1, 1913, value if such depletion would be in excess of the 27½ or the 50 per cent allowances. This provision will avoid the need of oil and gas valuations in any but the most exceptional cases.

Mining companies were gratified by the repeal of the capital-stock tax, with its requirements under department regulations for annual valuations of their properties; even though the repeal of this tax meant increasing by 1 per cent the corporation income tax. At least it did away with a separate tax and the bother and confusion of reports and determinations of it. Corporations naturally protested that with a corporation tax rate of 13½ per cent and with corporate dividends exempt to the extent of only the 5 per cent normal tax on individuals, corporation taxes were excessive and that a reduction, rather than an increase, should have been made. There seems some hope that, with the present act producing a revenue surplus, such a reduction in the corporation tax rate may be brought about.

The act continued the provisions of the prior act to the effect that distributions from depletion either on a basis of cost, March 1, 1913, value or discovery value should not be taxed as ordinary dividends, but were taxable only after the stockholder had realized from such distributions the cost or March 1, 1913, value of his stock, with such provisions applying either to foreign or domestic corporations.

In one feature the act departed radically from the revenue principle by its attempt to force the states to levy estate or inheritance taxes at rates of at least 80 per cent of those named in the federal act. This it does by providing that the federal tax payable should be credited, up to 80 per cent of its amount, with the amount of any similar tax paid to any state or territory. Since this means that the amount of the federal tax must in any event be paid, several states have already revised their laws so that the states themselves, rather than the Federal Government, shall receive this 80 per cent. Though as a tax it does not particularly affect mines, it is of interest as a deliberate, and to some extent successful, attempt of the Federal Government by indirection to dictate a tax policy to the states.

The state and local tax problem received greater attention in 1926 than for a long period. Federal taxes decreased, but there has been no such reduction in state and local taxes. In many cases these have continued to increase. Taxpayers generally seem to have abandoned the thought that they can obtain material relief from their own tax burdens by finding new sources of local revenues from which to meet expenditures. They seem rather to have turned to the thought that their tax relief must come from a better control of expenditures. Budgetary control has become generally recognized with great progress in municipal, county, and state budgets. Some progress has been made with the so-called "Indiana Plan" of a state board with power of approval, modification, or veto of any proposed local bond issues for improvements; but this has not been generally accepted, because it does such violence to every principle of the local control of financial affairs. Encouraging progress has been made through taxpayers' associations, which, in one form or another, particularly in the Western states, have been accomplishing most gratifying results. The most successful associations are those which do not represent any single industry or group of interests, but are really representative of the entire body of taxpayers. They are thus able among themselves fairly to consider the financial problems which must be met, and their suggestions and recommendations command a respect and accomplish results which otherwise could not be obtained.

The statement made before regarding search for new sources of revenue does not apply to the automobile situation. The wellnigh universal use of the automobile has brought a demand for expenditures for construction and for upkeep of roads which former sources of rev-

enue are recognized as wholly inadequate to meet. Growing costs of road maintenance and of bond interest and amortization charges have appalled taxpayers. The only way in which it seems possible to finance additional construction is for the users of motor vehicles in some way to pay these costs. The great variation in type and in use of motor vehicles made a tax on gasoline seem a most equitable means of raising revenues proportionately to the use made of the roads and of reaching not merely local, but also foreign, vehicles that were using such roads. This was the basis or the excuse for its adoption in many states. In certain states it was adopted without definite requirement that its proceeds should be devoted to road purposes, and this naturally has been the cause of protest against it as unfair taxation. However, where it has been adopted with the provision that its proceeds should be directly and exclusively applied to road construction or maintenance, it seems to have been generally accepted as an eminently fair tax. It seems destined to spread and to be accepted as a part of our general tax system.

There has been rather a noteworthy development in the definite establishment of New Jersey's policy of constructing great bridges and traffic tunnels to be paid for on a toll basis. The Delaware River Bridge, built jointly by New Jersey and Pennsylvania, was finally opened on a toll basis and on that basis has been carrying traffic with toll collections far beyond the most optimistic advance estimates and with little protest or complaint by users. Though this is by no means the first time that such public works have been constructed to be paid for on a toll basis, it is notable because of the interstate conflict it precipitated and because of New Jersey's definite adoption of tolls as the basis for financing such great improvements instead of attempting to finance them by general taxation.

The vehicular tunnels under the Hudson River are being built by New York and New Jersey, also to be paid for by tolls, and the Port Authority will also adopt the toll principle to pay for New York-New Jersey bridges which it is starting or for which it is planning. New York has also made an interesting arrangement for the Bear Mountain Bridge, built by a private company which will collect tolls therefrom for a given period of years, after which the bridge will revert free and clear to the state. Probably none of these projects could have been undertaken if they had had to be financed from ordinary tax levies. To this extent they deserve mention in a review of the tax situation for the past year.

Federal Mining Legislation

By Paul Wooton

Washington Correspondent of *Engineering and Mining Journal*

BECAUSE of the fundamental policy involved, great interest has attached at the session of Congress beginning in December, 1926, to the legislation carrying the appropriations for the Bureau of Mines. Western Senators, led by Senator Oddie, of Nevada, the chairman of the Committee on Mines and Mining, have thrown down the gauntlet to the Director of the Budget and will make a determined effort to provide for the initiation of the Bureau's economic work on a broader scale than would be possible otherwise.

As this is written (Jan. 15, 1927), the appropriation bill carrying the funds for the Bureau of Mines has not been reported from the committee, but it is practically certain that the House committee will not increase the amounts carried in the budget, and there are disquieting rumors of possible reductions. This is at a time when a revolving fund of hundreds of millions for agricultural relief is being discussed. The additional appropriations asked are intended for studies of certain of the economic problems of iron, gold, and silver; for research on manganese-bearing ores; for the study of the fundamental principles governing geophysical methods of prospecting; for the continuance of work on oil shale at the experimental plant at Rulison, Colo.; for specialized study of means to prevent falls of roof in coal and metal mines; for the replacement of an unserviceable mine rescue car; for the replacing of obsolete oxygen breathing apparatus; for the testing of electrical equipment for permissibility, and for the testing of explosives used in metal mines and quarries.

There is more involved in the fight for additional funds than the actual appropriations asked for would indicate. A committee of mining men, headed by J. V. W. Reynders, expended much time and money in a study of ways and means whereby the Federal Government could be helpful to the mining industry, which at that time was more greatly in need of relief than was agriculture. The committee, among other things, recommended this economic work. Its suggestions were constructive and sound. There was no suggestion to sell mineral products at home at prices in excess of the world price or to set up any sort of control. Assembly of essential information and certain studies of marketing, taxation, and distribution only were proposed. Transfer of the Bureau of Mines to the Department of Commerce was recommended for the express purpose of bringing the producers in more direct contact with the consuming industries, but as Senator Oddie puts it, the mining industry has been kicked in the face. Instead of providing for the proposed work the budget recommended less than was actually appropriated last year. For that reason the request for more funds takes on the character of a protest.

Decided progress was made with the Pittman bill providing for the purchase of 14,589,730.13 fine ounces of silver at $1 an ounce to complete the purchases specified in the war-time act.

Coal legislation met a decisive defeat when the House Committee on Interstate and Foreign Commerce voted against the bill proposing a plan for the meeting of emergencies.

Slab Zinc Production, 1926, by Quarters

Statistics by American Zinc Institute, in tons of 2,000 pounds

	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Total
Illinois	31,643	28,157	27,909	30,023	117,732
Arkansas	8,206	8,449	7,500	8,641	32,796
Kansas-Missouri	8,612	8,458	7,841	8,495	33,406
Oklahoma	41,202	38,300	34,812	38,502	152,816
Electrolytic	25,437	27,574	28,558	30,015	111,584
Other states	49,976	44,258	45,410	50,555	190,199
	165,076	155,196	152,030	166,231	638,533

United States Production of Refined Primary Lead

Data compiled by the U. S. Bureau of Mines in tons of 2,000 pounds.

	1921	1922	1923	1924	1925
Domestic desilverized lead	185,191	291,760	299,343	345,429	368,000
Domestic soft lead	209,250	190,749	203,615	260,560	248,000
Domestic desilvered soft lead	74,305	61,332	63,449	48,932	56,000
Totals	468,746	543,841	566,407	654,921	672,000
Foreign desilverized lead	63,916	74,481	124,086	112,048	128,000
Total refined primary lead	532,662	618,322	690,493	766,969	800,000
Antimonial lead	8,075	14,190	20,787	19,667	20,000

Railroad Transportation

By F. R. Raiff
Vice-President, American Smelting & Refining Co., New York

ANOTHER record-breaking year in the car-loading reports of the railroads will probably be recorded for 1926. During the first forty-three weeks actual loadings were 44,041,481 cars, compared with 42,338,949 cars for the same period in 1925, and the movement of this freight was accomplished with smoothness and regularity. There have been no embargoes except those local in effect and no shortage of cars that would impede the steady flow of commodities.

The organization of Regional Advisory Boards has been completed. These are fourteen in number. They were formed to provide a common meeting ground between shippers and railroads, to adjust informally differences that might arise between them and to give the shipping public a voice in the activities of the Car Service Division. The activities of these boards cover the whole country and have had much to do in the coordination of the work between the Car Service Division and the various industries and in preventing a shortage of equipment.

The coal strike in England had a marked effect in the movement of coal to tidewater for export from mines in the eastern section. For the first nine months of 1926, a total of 11,602,469 tons were dumped for export, compared with 4,279,135 tons during the same period in 1925.

The Interstate Commerce Commission has not as yet issued its report and order in its investigation of the rate structure of the country, although it is understood that its hearings have been completed. This is the investigation brought about by the Hoch-Smith Resolution No. 46—68th Congress (I.C.C. 17,000), looking to some relief to the farmer in rates on agricultural products and on livestock. It is expected that the Commission may have something to say on this subject shortly.

The new machinery for the adjustment of wage disputes between the railroads and their employees (the Watson-Parker bill) was given its initial tryout in the adjustment of the demands of some 89,000 conductors and trainmen on approximately fifty eastern roads, and whose demands approximated an increase of 19 per cent, or $38,000,000 yearly, for all employees involved. The decision of the Board of Arbitration given out Dec. 2, 1926, awarded increases of 7½ per cent in wages, or approximately $15,000,000 per year. The increase is effective Dec. 1, 1926, and averages about 42c. per day.

There have been no general changes in freight rates made by the railroads affecting the ores or metals of the non-ferrous producers, although some advances affecting copper bars, ingots, and other products are to be expected soon after the first of 1927 as applied to local traffic in the territory east of the Mississippi River. In August, 1925, tariffs were filed by the Eastern railroads making general advances in rates on these commodities. They sought, for example, to increase the New York-Chicago rate from $6.40 per ton to $9.50 per ton, with proportionate advances between other points. The tariffs were suspended pending an investigation by the Interstate Commerce Commission, the result of which was the Commission's order of Nov. 24, 1926 (I. & S. Docket 2,695), approving a New York-Chicago base rate of $8, with corresponding adjustments at intermediate points, and a sixth-class basis between other points not affected by the New York-Chicago scale.

Labor Situation at the Mines

METAL MINING was remarkably free from labor troubles during 1926. There was no material change in wage schedules, although the price of iron ore, copper and silver was less than in 1925.

The Michigan copper district reported a shortage early in the year, but conditions improved substantially during the latter part of 1926, and the several companies enter the new year with larger and better-balanced underground forces. One thousand more men are now employed than a year ago. At Michigan iron mines, due to the greater use of underground scrapers and small hoists, less labor is required. Many mines doubled their production by these additions without taking on more labor. The labor supply in Minnesota was ample for the year, no change in wage scales taking place. No labor troubles were experienced, as labor realizes it is being paid all that can be expected at the present price of iron ore.

In the Tri-State lead and zinc district, mine operators find themselves with an abundance of labor. The excess of labor is due to the fact that only 164 mills are now operating, as compared with 183 in February. The district continues to operate on the sliding wage scale, based on the zinc price. The system seems to be a solution of the labor problem. An effort was made to unionize the miners of the district last winter, but it resulted in failure, the last of the union organizers leaving the district at the beginning of 1926. Wage scales in western states are given below.

Metal Mine Wage Scale in Western States

(Compiled by Colorado Mining Association, Denver, Colo.)

Mines	Ariz. (a)	Calif. (c)	Idaho (a)	Mont. (b)	Nevada (c)	New Mexico (b)	Utah (c)	S. Dak. (b)	Colorado Northern (c) Districts	Colorado Lake (c)	Colorado San Juan (c) District	Colorado Teller (a)
Engineer, hoist	$5.78–$6.33	.....	$6.00	$6.00	$5.00–$6.00	$5.25	$4.50–$6.00	$5.25	$5.00	$4.75–$5.25	$4.65–$5.00	$4.25–$5.25
Pipe and track men	5.23– 5.75	.....	5.50	5.50	5.25– 6.00	2.50 Mex.	4.75– 5.50	5.50	4.00–$4.50	4.50– 5.00	4.50– 6.00	3.75
Timbermen	5.23	$5.00	5.75	4.75	5.25– 6.00	5.25	5.00– 5.25	4.75	4.50– 5.00	4.50– 5.00	4.50– 5.00	4.25
Machine miner	4.95	4.50	5.25	4.75	5.25– 6.00	5.25	5.00– 5.25	4.75	4.50– 5.00	4.75– 5.00	4.50– 5.00	4.50
Mucker or trammer	4.40	3.50	4.75	4.75	4.50– 5.25	4.00	4.50– 4.75	4.25	4.50	4.00– 4.25	4.00– 4.50	3.75– 4.25
Cage tender	5.23	.....	5.50	4.75	5.00– 5.75	5.25	5.00– 5.50	4.25	4.50	4.50– 4.75	4.50	4.25
Common labor	4.40	3.50	4.50	4.25	4.50– 5.25	4.25	3.75– 4.75	5.50	4.50	4.00– 4.25	3.50– 4.50	3.75– 4.25
Pumpman	5.23	5.25	5.50	5.50	5.00– 6.00	5.25	4.50– 6.00	5.00	4.50	4.75– 5.00	4.50	4.00
Blacksmith	5.23	6.00	6.00	5.50	5.50– 7.00	5.25	5.50– 5.75	5.25	5.00	5.00– 6.00	5.00– 6.00	4.50
Mills												
Mill foreman	.....	.....	7.00	6.00	.....	250	6.00– 6.50	6.50	5.00	6.00	.....	.....
Shift boss	5.75	.....	6.00	.....	.....	180	6.00– 6.50	5.75	5.00	5.00	4.50– 7.00	6.50
Tableman	4.40	4.00	5.50	.....	5.00– 6.00	4.00– 4.25	4.25– 4.75	4.00	5.00	4.00– 5.00	3.75– 4.75	5.00
Millwright	5.15	.....	5.50	.....	5.45– 8.00	5.25	5.50– 5.75	4.75	5.00– 6.00	5.00– 6.00	6.00– 7.00	5.00
Electrician	5.23	.....	6.00	5.85	6.00– 7.50	5.25	5.50– 5.75	5.50	5.00	5.00– 6.00	5.75– 6.50	4.00
Tram men	.....	.....	5.50	.....	.....	.....	4.75	4.00	4.50	4.00– 4.50	4.00– 5.00	4.00
Common labor	2.75	3.50	4.50	3.75	4.50– 5.00	2.50 Mex.	3.60– 4.50	3.50	4.00– 4.50	3.75– 4.00	3.50– 4.00	3.50
Truck driver	3.75	.....	5.25	4.25	.....	4.00– 4.25	4.00– 5.25	3.75	4.00– 4.50	4.00– 4.50	.....	4.00
Machinist	5.23	4.00	6.00	5.00	6.00– 6.50	5.25	5.50– 5.75	5.25	5.00	4.75– 5.00	5.50– 7.00	5.00
Crusherman	4.40	.....	5.00	.....	4.50– 5.25	3.45 Mex.	4.00– 4.75	4.50	4.00– 4.50	4.00– 4.50	4.00– 5.00	4.00

(a) Established wage. (b) Paid by leading operators. (c) Average.

FOREIGN TRADE *in Metals and Minerals*

By Arthur B. Parsons
Assistant Editor, *Engineering and Mining Journal*

SUBSTANTIATION of what already was known—the phenomenally high rate of manufacturing and construction activity in the United States during 1926—appears in the figures of import and export of metal and non-metallic commodities. Comparative figures for the first eleven months of 1925 and 1926, as reported by the U. S. Department of Commerce, are shown in the accompanying table.

During 1925 the country enjoyed reasonable industrial activity; yet in 1926 net exports of copper, of which domestic production exceeds consumption, declined from 200,000 to 75,000 tons; and those of zinc from 84,000 to 42,000 tons. At the same time, whereas the net imports of lead were only 6,000 tons in 1925, they reached 59,500 tons in 1926. These data emphasize the capacity of domestic industry to absorb metal. Gold, of which the United States now has a disproportionately large stock, shows a reversal of flow. Net imports of $88,000,000 in 1925 were succeeded in 1926 by net exports of $135,000,000.

Fertilizer materials, bauxite, and salt, were virtually the only mineral products of which United States is a large importer for which appreciable increases are not reported. The more important commodities, with the percentage increase shown after each, follow: aluminum (52), cobalt (50), antimony (33), nickel in ore or matte (33), manganese (28), quicksilver (26), tungsten (25), platinum (13), and tin (2.5); and among the non-metallics, fluorspar (30), mica (30), gypsum (28), magnesite (23), asbestos (16) and diamonds (14).

United States Commerce in Ores and Metals

Eleven-month periods ending with November. Figures in pounds, unless otherwise stated.

I—Copper

	1925	1926
Imports		
Ore, concentrates, matte	152,479,705	137,098,172
Unrefined, black, blister	346,527,623	446,384,954
Refined	85,553,997	119,601,666
Old	9,834,749	12,216,009
Total	594,396,074	715,300,801
Exports		
Refined	901,130,114	771,043,399
Rods	51,446,163	40,090,790
Wire	10,710,030	12,393,405
Cable	15,535,249	17,282,589
Other forms, including scrap	25,682,097	23,976,329
Total	1,014,503,653	864,786,512

II—Lead

Imports		
In ore and matte	81,360,910	101,684,239
In bullion	121,825,869	140,976,898
In pigs, bars and other forms	11,397,430	18,461,987
Scrap, babbitt, etc., lead content	1,220,975	2,228,532
Type metal, lead content	2,628,978	6,555,160
Total	218,434,162	269,906,816
Exports		
In pigs and bars—		
From domestic ore	7,701,580	7,463,100
From foreign ore	185,417,514	119,256,844
Manufactures	13,334,064	23,784,970
Total	206,453,158	150,504,914

III—Zinc

Imports		
Ore (duty paid)	23,611,329	27,133,259
Ore (duty free)	969	116,572
Blocks and pigs	42,517	40,027
Total	23,654,815	27,289,858
Exports		
Ore concentrates and dross	30,934,032	20,307,875
Slabs, blocks and pigs	147,939,593	76,226,366
Sheets, strips and other forms	7,530,170	8,696,796
Zinc dust	4,082,766	1,985,201
Other zinc manufactures	1,225,692	3,862,763
Total	191,712,253	111,079,001

IV—Gold and Silver

Imports		
Gold, value	$196,500,366	$121,057,168
Silver, value	65,139,306	58,848,462
Exports		
Gold, value	108,511,537	256,672,063
Silver, value	86,647,359	91,538,115

V—Exports of Minor Metals and Minerals

Aluminum: Ingots, scrap	8,098,421	535,049
Manufactures	7,288,556	7,412,477
Quicksilver	13,233	7,582
Nickel, metal and alloys	2,321,852	1,481,100
Platinum, oz	14,897	9,976
Tin bars	758,993	1,432,680
Tin manufactures	4,169,172	5,307,779
Asphalt and bitumen, tons	24,500	31,451
Manufactures of, lb	84,722,412	46,172,442
Sand and gravel, tons	355,618	346,003
Cement, bbl	919,274	884,250
Fireclay, tons	33,150	39,282
Other clays, tons	32,410	34,684
Asbestos, tons	989	701
Asbestos manufactures	10,572,367	10,907,074
Gypsum	30,027,574	35,686,925
Mica and manufactures	2,296,212	2,197,545
Sulphur, tons	571,225	531,665
Salt, tons	136,593	141,959
Graphite: Unmanufactured	1,723,888	672,045
Manufactured, except crucibles	2,202,911	3,277,714
Phosphate, tons: High grade hard rock	149,310	98,422
Land pebble	609,836	597,749
Other phosphate rock	12,258	10,728
Borax, tons	15,476	13,373
Ocher, umber, sienna, whiting, etc., tons	13,965	14,625
Magnesia and manufactures	4,738,604	5,903,914

VI—Imports of Minor Metals and Ores

Aluminum, metal, scrap, and alloy	32,542,777	67,185,483
Antimony in ore	1,533,133	3,017,268
Metal	19,016,507	27,371,254
Cobalt	203,073	487,650
Platinum, oz	94,646	108,339
Iridium, oz	2,179	3,074
Osmium and osmiridium, oz	3,839	5,992
Palladium, oz	7,068	7,732
Rhodium and ruthenium, oz	3,737	1,700
Quicksilver	1,388,446	1,960,430
Nickel: Ore and matte	8,358,995	12,927,138
In pigs, ingots and other forms	28,116,735	26,738,543
Manganese ore, tons	253,692	341,195
Chrome ore, tons	136,891	204,220
Tin, bars, blocks, pigs, tons	77,500	79,270
Tungsten	2,475,552	3,229,168
Ferrochromium, chromium metal and chrome-vanadium	1,260,390	1,175,267
Ferrosilicon (silicon content)	9,885,158	26,394,170

VII—Imports of Non-Metallic Minerals

Bauxite, tons	337,870	268,118
Marble, cu.ft	588,725	804,110
Sand and gravel, tons	452,165	777,854
Lime and limestone, tons	15,688	24,576
Kaolin, china and paper clay, tons	305,725	325,590
Other clays, n.e.s	50,140	79,242
Corundum, tons	1,328	4,153
Emery, tons	6,795	4,237
Flint, tons	13,688	12,911
Asbestos, unmanufactured, tons	188,257	210,125
Asbestos, manufactured, tons	14 897	29,395
Cryolite, tons	9,780	7,617
Chalk, crude, tons	92,971	90,754
Fluorspar, tons	42,624	60,471
Gypsum, crude, tons	492,913	679,399
Mica, crude	582,355	760,995
Mica, cut, split	4,192,324	5,974,033
Diamonds, rough, carats	160,926	223,435
Cut, unset, carats	475,326	513,446
Pyrites, tons	270,157	349,378
Talcum, steatite, French chalk, tons	19,470	22,784
Magnesite, tons	66,972	86,868
Salt, tons	75,379	59,509
Graphite	29,904,576	29,367,002
Mineral wax	4,996,930	7,811,648
Iodine, crude	214,201	641,089
Nitrate, sodium, tons	1,069,208	850,634
Ochers and sienna	18,538,354	20,086,861
Lithopone and other zinc pigments	14,641,528	17,066,797
Potash, tons: Crude chloride	142,613	178,798
Crude sulphate	62,877	63,313
Kainite	163,067	151,498
Manure salts	341,918	280,727

VIII—Iron Ore and Pig Iron

Exports		
Iron ore, tons	629,571	868,405
Pig iron, tons	30,048	22,557
Imports		
Iron ore, tons	1,950,648	2,350,406
Pig iron, tons	388,092	430,990

NEW MACHINERY

EQUIPMENT *Lines Show Improvements*

Advance Made in Crushing and Grinding Units, Filters, Locomotives, Fans and Electrical Applications

By A. H. Hubbell
Managing Editor, *Engineering and Mining Journal*

HOW THE MACHINERY MANUFACTURER contributed to the progress made in the mining and metallurgical industries in 1926 is indicated by the new designs and models in the major lines of equipment that made their appearance. Radical changes were few; new sizes of existing models were many. Such is usually the case. Accessory devices and appliances were numerous. Accomplishments were, briefly, as follows:

Drills—Changes made in existing rock drill models were of a minor sort looking to greater efficiency. Attention was directed to self-rotative stopers, preferably of a rifle-bar type, which appeared to gain in popularity for use in confined space where ground is hard. The principle of air-line oiler lubrication received greater acceptance. Forging, heat-treating, and sharpening equipment, with respect to drill-steel practice, was improved, keeping step with improvement in the practice. An 1,100-lb. all-hammer sharpener was introduced.

Two new diamond core drills appeared, one for oil-field service in particular, a heavy structure-testing outfit capable of removing a 2-in. core to 2,000 ft.; the other a light prospecting rig for surface and underground work that will take a $1\frac{1}{8}$-in. core to 1,000 ft. and which is driven by air or steam-turbine motor, or by electricity.

Compressors—The introduction of new models of portable units, improved in details and of varied drive, was the chief point of note in the compressor field.

Fans and Blowers—Taking the stand that the complex conditions of secondary mine ventilation cannot be met by one type of fan, a leading manufacturer followed his introduction last year of a medium-pressure volume-type blower for short ducts of large diameter, by putting on the market in 1926 a blower giving comparatively high static pressure and suitable for small ducts (6 to 12 in. in diameter) of over 1,000 ft. or more in length.

Construction of two sets of motor-driven centrifugal compressors to furnish large volumes of air at low pressure for flotation work was begun for a Western copper company. Each will consist of a 1,250-hp. synchronous motor driving a centrifugal blower rated at 60,000 cu.ft. per minute at 3.4 lb. equivalent sea level rating. At the altitude of the plant this means delivery at $2\frac{1}{2}$ lb.

Air Filters—A filter of new design was introduced. It consists of dry plates arranged so as to change the direction of the air current frequently and provided with hair-like tentacles to catch the dust carried by the air. This requires no oil or grease and is said to be non-cloggable.

Hoists—Construction of several large hoists was undertaken. One of these will be physically the largest electric hoist with direct-connected motor ever built by one manufacturer in the United States. It will have steel plate drums of 12-ft. diameter and 8-ft. face, with a maximum rope pull of 56,800 lb. at the drum and a maximum rope speed of 2,250 ft. per minute. The drums have been especially designed in an effort to increase the rope life. The hoist will be operated by a 2,000-hp. d.c. motor capable of handling peak loads of 4,500 hp. torque. Its design will provide for manual control by an operator at the platform or for semi-automatic operation from three different levels. This will be the first hoist in the United States to be built for semi-automatic control and to operate from the stated depth at the rope speed given.

Unusual features mark an electric hoist built for a submarine coal operation in Nova Scotia. This hoist is to be used chiefly to lower its load and in so doing will return power to the line. It is equipped with a 400-hp. motor, which is mounted on the hoist bed directly back of the drum in order that the clear span of the roof (underground) need be no greater than necessary. Every part will pass through a 5x6-ft. opening. Double reduction gears are used to keep down the diameter of the drum gear. To permit quick repairs all bearings have renewable sleeves. All parts are bolted. The electric equipment is flame-proof.

Portable slusher hoists underwent further development, particularly in electric motor-driven units. Two new sizes, with 15 and 25-hp. motors, were introduced for underground scraper work. Another scraper hoist, equipped with a silent chain drive, was developed for working at 350 to 400 ft. per minute.

Haulage—The oil-electric locomotive, introduced last year, continued at the focus of attention. One large copper company undertook to test it in actual service and other applications were announced. The fact that this locomotive is entirely self-contained and can remain continuously in service places it in a class by itself.

Additions to various lines of mine locomotives—of gasoline locomotives in particular—were announced. Among these were four sizes, ranging from 8 to 20 tons. of gear-driven gasoline locomotives having three-point suspension and cross-equalization and other features. A 24-ton gasoline locomotive was also introduced.

A device for replacing the discharged battery on a storage-battery locomotive with a fully charged battery was brought out.

A large copper company installed an electric haulage system, beginning with six 76-ton and three 30-ton engines, all of standard gage and carrying both trolley and third rail shoes, taking current at 600 volts d.c. The heavy engines carry a 230-volt, 152 kw.-hr. storage battery, arranged for automatic charging. These engines will also handle 30-in. gage cars, using a common rail and a single drawbar. The light engines are used

for pushing cars on adjacent tracks by means of a huge steel arm, air operated, which may be turned to either side or held up out of the way.

Pumps—Automatic pumping made progress. The electrical control parts required were standardized to make possible immediate quotation to prospective users. A check valve switch and a special diaphragm sump switch for this work were introduced. As to pumping in general, refinements were made in details, tending toward bettering the pump as a unit to secure greater efficiency, ease in handling, and smoothness in operation.

Excavators, Shovels—The trend toward the electric shovel and the substitution of caterpillar mounting for trucks under shovels of older type continued. Caterpillar mounting was applied to a 500-ton dragline with success. Several shovels of small and intermediate sizes and designed throughout to handle a dipper of the size at which they are rated were introduced. A track-shifting machine of improved design appeared.

One manufacturer built a full Diesel-electric dipper dredge of 1,200 hp. for underwater rock excavation and undertook the construction of what will be the world's largest Diesel-electric hydraulic dredge.

Developments in underground loading machines consisted in improvements in details to enable them the better to withstand the severe service to which they are subjected.

Crushing, Grinding—With the object of combining in one machine the advantages of the horizontal disk crusher and of the vertical disk type, one manufacturer developed a crusher having a conical head (of manganese steel) gyrated by an eccentric that is driven through gears and a countershaft. Opposing the head is a crushing bowl threaded for the purpose of raising or lowering it. The gyration moves the head through a much greater distance and much faster than in the ordinary gyratory, the resultant effect being to give a higher crushing efficiency.

Three 60-in. gyratory crushers were constructed. Two of these, the world's largest, weigh about 1,000,000 lb. each, and will handle 2,000 to 2,500 tons per hour, reducing the ore to 12 in. size.

Among the refinements made in jaw crushers was a safety device to guard against serious breakage in case of overloading or introduction of tramp iron. This consists of a small steel plate and a hardened steel punch set into a recess in the rocker supporting the front toggle plate. A dangerous strain will force the punch through the plate, allowing the toggles to drop a short distance and put the machine out of action.

In grinding, the tendency has been to go to bigger and better built ball mills and rod mills, the evident reason being that the larger units carry such a large per cent of the milling load that they must be run with the minimum lost time.

For grinding abrasive materials an interesting development was the combination of a conical ball mill with a reverse current air classifier, this decreasing the wear on piping and other parts to a negligible amount. The same combination was applied to grinding coal, quantities as small as 100 lb. per hour being handled efficiently.

Screens—Popularity of the vibrating screen continued. Several new models appeared. Strength, lightness, and simplicity, together with high grinding efficiency, were the objectives. In one of these the vibration is imparted directly to the screen sash through rigid members by reciprocating motors, the machine being without bearings or moving parts. Another development was the application of the rotary grizzly to gravel plant and quarry use. A rubber-metal screen appeared.

Filters, Thickeners—Use of the disk type of filter increased, the partitioning of the tank where more than one disk is used permitting two or more products to be filtered on the same machine. To meet this competition the drum-type filter with a double drum was introduced. To take care of any possible difference in vacuum requirements on the two drums, each drum is provided with a separate valve, thus enabling close vacuum control to be obtained.

A new continuous centrifugal filter made its appearance. This is a small self-contained unit, operating at comparatively low speeds and requiring no cloths, screens, or other filter mediums. This machine is intended for use with sand slimes, flotation concentrates, powdered coal, and materials of similar characteristics.

Another new machine was a continuous thickener of the filter type. This consists of a tank in which are suspended a large number of filter elements, each of these consisting of a round grooved redwood stick about 40 in. long and 2¾ in. in diameter and having a longitudinal hole communicating with radial holes, the whole covered with cloth. Vacuum and pressure are produced at the proper point of the filtering cycle by means of an automatically reversing wet vacuum pump.

An automatic density valve, introduced late in 1925, found ready reception in the industry.

Flotation—To avoid the difficulty caused by the deposition of lime in the flat stationary blanket used in pneumatic flotation cells, a new machine was introduced, the main feature of which is a revolving canvas-covered rotor, through the hollow trunnions of which air at 1½ to 2½ lb. pressure is introduced. A saving in power cost and in blanket renewals is thus effected.

One manufacturer undertook to supply 25- and 50-ton all-flotation units in standard layouts completely assembled in a structural steel frame, necessitating only foundations.

Precipitation—Developments in the electrical precipitation field were: The application in the metallurgical industry of the rod curtain type of precipitator on a large scale; the development of the graded resistance electrode type of precipitator in the cement industry; and the equipping of a large number of precipitation installations with radio interference correction equipment. The advantages of the rod curtain referred to are that, being discontinuous, it is free from mechanical stresses and that the rods can easily be replaced when corroded. The graded resistance electrode type of precipitator has the advantage of reducing the effect of deposits and of more uniformly distributing the electrical discharge.

Furnaces — Multiple hearth furnaces were built equipped with the modern inclosed speed reducer, with all steel gears operating in an oil bath, instead of the open gearing hitherto used. The speed reducer was adopted as standard for these furnaces. This drive is safer and cleaner and is self-lubricating.

Conveying—The increasing application of roller bearings to conveying equipment was the principal feature in this line. Improvements in details were effected. Among these were a belt governor, providing a sturdy, efficient short-center drive, and a cast-iron troughing idler for ore-handling service.

Power Transmission—Two sets of helical gears were turned out for driving the largest installation of ball mills ever put into service. These gears were 13½ ft. in diameter and 17½ in. in face. The reduction was 14.82 to 1.

Power—Following central station practice, industrial power plants in general displayed a tendency toward the use of higher steam pressures, air preheaters, and other modern accessories. It is now possible to get steam turbines in small sizes, of guaranteed high efficiency and high back pressure exhaust. Construction of a number of steam turbines of record size was begun. Larger turbine generator sets of the bleeder type were supplied to companies using turbine steam for process work, and definite increase in capacity of turbines for mechanical drive, particularly for running large compressors, was reported.

The use of Diesel and semi-Diesel engines increased. Of the year's total sales it is estimated that 4.3 per cent were in the mining field and 20 per cent in the oil industry for pipeline work.

Successful application of the system of motor control by means of field control of the generator was made in the operation of ore and lift bridges, car dumpers, and similar equipment. A general trend toward push-button control, the ventilation of motors, and the use of safety switches was noted. On the whole considerable progress in electrifying plants was made.

MARKETING AND STATISTICS

COPPER *Production Absorbed by Market*

Copper Exporters, Inc., Starts to Function

By Joseph Clendenin
Manager, Sales Department, Guggenheim Brothers, New York

THE OUTSTANDING DEVELOPMENT of 1926 in the copper industry was launching Copper Exporters, Inc., which started doing business Oct. 15, 1926. It was not to be expected the organization would function perfectly at the start, as it involved changes in conduct of the export trade firmly established for many years. There is no reasonable doubt the corporation will accomplish all that was claimed for and expected of it.

The statistics (in net tons) covering refined or marketable copper in North and South America show the following:

1926	Total Deliveries, Net Tons	Stock at End of Period, Net Tons	Changes in Stock, Net Tons	Price Received in Cents per Pound—*E. & M. J.* High	Low
First quarter.....	344,186	75,206	+2,124	14.425	13.900
Second quarter.....	356,053	66,096	—9,110	14.050	13.775
Third quarter.....	367,294	70,137	+4,041	14.525	13.875
Fourth quarter.....	360,502	85,501	+15,364	14.250	13.275

The entire production of marketable copper during 1926 was delivered for consumption, excepting 12,000 tons, yet the price obtained as reflected by the *Engineering and Mining Journal* ranged from a high of 14.525c. per pound in early August to 13.275c. per pound at the end of the year. The takings for 1926 exceeded those for 1925—which was a record for all peace times—in the aggregate by 12,000 tons; domestic deliveries increasing by 71,000 tons, or 9 per cent; export deliveries decreasing by 59,000 tons, or 10 per cent.

The stock of marketable copper at the end of 1926 shows an accumulation of 12,000 tons, against deliveries of 1,428,000 tons. The market price began to recede in October on vague rumors of increasing production, steadily declining thereafter to the end of the year, with a drop of approximately ¾c. per pound, due chiefly to wide public and private circulation of reports as to increased production, which fail to show up in the statistics.

Much emphasis has been laid upon the production for November, which, multiplied by twelve, is made to indicate a large increase in production for next year. Such a computation, taking any one month as a basis, in the mining and smelting business is an absurdity. No one was alarmed nor more than mildly interested when the three months (March-May) production of blister, North and South America, was shown to be 335,000 tons. The fact is, when this increased production came on the market in the third quarter, the price was the best of the year, averaging 14.30c. per pound. By contrast we have production for the three months (October-December) heralded as excessive, record-breaking, and the like, with the price for the fourth quarter averaging 13.85c.; but because of extreme pressure to sell, the price at the end of the quarter is down to 13¼c. In other words, an increase in three months' production equal to a three days' supply caused a break in the price of more than one cent per pound. History repeats itself. Such occurrences are not rare in the copper industry. Unreasoned apprehension will in due time give place to reasoned confidence. This country is now consuming 64 per cent of North and South American refinery output, compared with 40 per cent before the war. Europe is turning the corner and is sure to do better in 1927 in its takings.

The figures showing supply and demand for the last several years are given in the accompanying table.

Copper Supply and Demand, 1922-1926

	Average Monthly Deliveries, Tons	Stock at End of Period, Tons	Changes in Stock, Tons	Average Monthly *E. & M. J.* Quotation High, Cents	Low, Cents
1922.....	75,617	149,393	—118,575	14.074	12.567
1923.....	96,449	155,885	+6,492	16.832	12.574
1924.....	109,982	136,434	—19,451	14.260	12.327
1925.....	117,977	73,019	—63,415	14.353	13.866
1926.....	119,003	85,501	+12,482	14.174	13.302

Production of refined copper in North and South America was 1,440,000 tons in 1926, against 1,352,000 tons in 1925, an increase of 88,000 tons. The stock of refined copper in North and South America on Jan. 1, 1926, was 73,000 tons and on Dec. 31, 1926, it was

85,000 tons, an increase of 12,000 tons, showing that the larger output of refined copper in the Americas was practically all shipped to consumers. There are officially and publicly known figures showing refined copper stocks at three other important storage points in the world.

On Jan. 1, 1926, there were 6,200 tons of refined copper in the United Kingdom, 3,400 tons in France, and 5,500 tons in Japan—a total of 15,100 tons. On Dec. 31, 1926, there were 4,500 tons of refined in the United Kingdom, 9,700 tons in France, and 3,700 tons in Japan, a total of 17,900 tons, or an increase during the year of only 2,800 tons at these three storage points. This, added to the increase of 12,000 tons in this hemisphere, gives an increase of less than 15,000 tons in the world's stocks of refined or marketable copper during the year 1926. During the year the world production of refined copper probably amounted to 1,600,000 tons, all of which went into consumption excepting the 15,000 tons mentioned above, or about three days' output. In other words, the production and consumption of marketable copper was held in the closest kind of balance during the year. The most recent report of world stocks assembled by American Bureau of Metal Statistics shows a twenty-day supply of marketable copper.

Stocks, Refinery Production and Shipments, in Tons and Price of Copper, 1921-1926

At End of	Stocks of Marketable Copper	Refinery Production, North and South America	Domestic Shipments	Export Shipments	Total	Price Average for Year, F.o.b. Refinery *E.&M.J.* Cents
1921	268,000	537,200	307,300	282,700	590,000	12.502
1922	149,400	788,800	549,800	357,600	907,400	13.382
1923	155,900	1,163,800	735,500	421,900	1,157,400	14.421
1924	136,434	1,300,332	753,389	566,395	1,319,784	13.024
1925	73,019	1,352,309	831,171	584,553	1,415,724	14.042
1926	85,501	1,440,454	902,174	525,861	1,428,035	13.795

Distribution of Refinery Shipments for Years 1925 and 1926

In Short Tons

Shipments to	1925 Tons	1925 Per Cent	1926 Tons	1926 Per Cent	Tons, Increase or Decrease
United States	831,171	58.70	902,174	63.18	+71,003
Belgium	45,419	3.21	42,076	2.95	—3,343
Canada	12,281	0.87	15,673	1.10	+3,392
England	113,505	8.02	117,457	8.23	+3,952
Far East	13,217	.93	24,463	1.71	+11,246
France	96,547	6.82	103,173	7.22	+6,626
Germany	151,043	10.67	105,242	7.37	—45,801
Holland	49,269	3.48	34,021	2.38	—15,248
Italy	80,093	5.66	57,763	4.04	—22,330
Norway and Sweden	14,093	1.00	13,554	0.95	—539
Others	9,086	0.64	12,439	0.87	+3,353
Totals	1,415,724	100.00	1,428,035	100.00	+12,311

The figures covering the world production of primary or rough copper are fairly complete and reliable. As against a world output of primary copper of 1,588,000 tons in 1925, there was produced in 1926 a total of 1,658,000 tons—an increase of 70,000 tons. The stock of rough copper in all forms in North and South America was 249,000 tons on Jan. 1, 1926, and 276,000 tons on Dec. 31, an increase of 27,000 tons. The stock of rough copper in the United Kingdom was 56,500 tons on Jan. 1, 1926, and 30,000 tons on Dec. 31, a decrease of 26,500 tons. These are the only major stocks of rough copper in the world, and the figures covering them are entirely reliable. It is important to note that the increase in the Americas has been offset exactly by the decrease in the United Kingdom. This confirms the only deduction possible from the figures covering refined marketable copper—namely, that while the world production of primary copper increased 70,000 tons in 1926, the entire 70,000 tons was absorbed by consumptive demand.

This exhibit in itself is good—it would have been much better but for the recent raid on the price, which caused consumers to reduce their stocks and stop buying. This situation should right itself during 1927. A continuation of the large 1926 domestic takings, coupled with the generally expected larger foreign takings (probably as much as those for 1925), ought to take care of the increased production now in sight, some of which will not be ready for the market until well on into 1927.

It might be well to remember that world production is known currently from month to month, but that there is no such knowledge of consumption, because of varying stocks carried by consumers in the course of the year. The surprise for 1927 may prove to be in the rate of consumption, rather than in the rate of production, which is now so much a matter of discussion and concern to others than to the producers themselves.

LEAD *Scores World's Largest Production*

German Consumption Declines, but Other Countries Increase Theirs

By F. F. Colcord

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FAILURE of Germany to maintain its 1925 rate of consumption and the world's largest production of all times were the marked features of the 1926 lead market. German consumption, which jumped from about 84,000 metric tons in 1924 to approximately 172,000 metric tons in 1925, declined to an estimated consumption of 141,000 metric tons in 1926. The United Kingdom, on the other hand, and in spite of its prolonged coal strike, maintained its 1925 figure of net imports. Practically all of the other lead-importing countries bettered their 1925 figures. Consumption in the United States continued at a high rate during the year, so that the world's increased production was rather easily absorbed.

Practically all producing countries contributed their share of the increased production, Spain, Canada, Mexico, British India, and Australia being the largest contributors, with the United States showing only a slightly increased production. Undoubtedly the price level of 1925 was the stimulus for the increase, and that such stimulus is necessary is indicated by the average 1926 price, estimated at 8.41c. New York. Production and consumption went on apace during the year, and the price slump in the early part of the year was due more to a temporary spread between available production and consumption than to any real slackening of consumption. This temporary oversupply occurred abroad, while refined stocks in the United States and

Mexico remained practically unchanged from previous months. In fact, refined stocks in the United States and Mexico reached their maximum after the market had started on its upward climb. Stocks of lead in ore, matte, and base bullion in the United States and Mexico were higher during the year than previously, but this is a concomitant of a greater production; for proportionately large ore stocks are necessary and a larger amount of bullion must necessarily be in transit.

The year opened with a London price of £35 and New York at 9¼c., with the market statistically strong. The only impending clouds were depressed conditions in the metal industry in Germany and a threatened coal strike in England. Strength was displayed during January; but belated Australian shipments arriving in England during the quietest period of the year, with German business continuing dull, together with an expected increase in production, resulted in an easier tone by early February. Water shortage in Australia threatened to curtail Broken Hill output seriously, but fortunately abundant rainfalls arrived in time to prevent anything more than temporary shutdowns at the mills. By the middle of February the decline in London forced lower prices in the United States, and from then on it seemed to be a question as to which market could decline the faster, although English and United States consumption was satisfactory. Two factors accentuating the decline were undoubtedly heavy "bear" operations on the London Metal Exchange and the sentimental effect of the stock-market debacle on Wall Street. The decline continued during March, April, and May, and buyers, pursuing a watchful-waiting attitude, were successful in buying at ever lower levels.

June was the turning month. The English coal strike failed to affect the market materially. Germany gained considerable ground, and the United States continued at a high consumption level. The market kept on climbing, and August saw the highest prices of 1926 since January. In September the market weakened and started to decline. This second decline of the year proceeded in an orderly manner for the remainder of 1926. Production increased somewhat, but the cautious attitude toward next year's business, which has characterized the fall months of the past few years, asserted itself, and buying was steady but not active. The automobile industry in the last quarter of 1926 had its usual seasonal decline, with its consequent adverse effect on the market.

Comments made last year on the similarity of the price movements for 1923, 1924, and 1925 apply equally well to 1926. The high and low points for these years closely coincide, the high points occurring early in the year, the low points in the spring, with a substantial rally by summer time. The price movement in the United States is indicated by the New York lead quotations of the American Smelting & Refining Co., which for the year were as follows:

	Cents Per Lb.		Cents Per Lb.		Cents Per Lb.		Cents Per Lb.
Feb. 11	9.15	April 19	7.85	July 14	8.50	Oct. 25	8.25
Feb. 25	9.00	May 11	7.75	July 23	8.65	Nov. 1	8.10
March 1	8.90	May 21	7.65	July 26	8.75	Nov. 3	8.00
March 3	8.75	June 10	7.80	July 30	8.90	Dec. 6	7.90
March 8	8.60	June 11	8.00	Sept. 13	8.75	Dec. 15	7.80
March 10	8.40	June 15	8.15	Oct. 1	8.65		
March 12	8.20	June 16	8.25	Oct. 6	8.50		
April 7	8.00	July 13	8.40	Oct. 13	8.35		

The outlook for 1927 is promising. It seems hardly possible that any substantial increase in production is to be expected. Consumption the world over should maintain its present pace. Germany is expected to increase its consumption over 1926, and any slackening in the automobile or other demand in the United States should be offset by an increased foreign demand. The present low cotton price and the low price of agricultural products may have some adverse effect in the United States, but these prices are likely to rectify themselves, and a fairly steady lead market may be expected.

WORLD ZINC *Production Breaks All Records*

Producers and Consumers Lightly Stocked at Close of 1926

By E. N. Hickman

Executive Sales Department, The American Metal Co., Ltd., New York

ALTHOUGH the world's zinc industry broke all production records in 1926, the price of the metal ranged within relatively narrow limits for the greater part of the year. Figures available at this writing [end of December] indicate a world's production of 1,370,000 tons. Of the increase this country, which furnishes nearly half of the world's supply, accounted for 50 per cent and established a production figure only exceeded in 1916 and 1917. Canada's output, largely of high grade, increased from an average of 3,200 tons per month in 1925 to over 5,000 tons per month in 1926; Belgium, the largest Continental producer, is now supplying over 18,000 tons per month as against 16,000 tons during 1925, and Germany and Poland each registered large gains. On the other hand, Australian production has not changed, and, for the last half of 1926, owing to the coal strike, England has produced nothing.

The following table (in tons of 2,000 lb.) summarizes the growth of zinc production in recent years, and the United States' share in it:

	1913, Tons	Per Cent of Total	1917, Tons	Per Cent	1922, Tons	Per Cent	1926, (*a*) Tons	Per Cent	Per Cent Increase 1913-1926
United States	352,952	32	682,225	62	373,678	47	640,000	47	81
Rest of the world	760,908	68	423,601	38	425,602	53	730,000	53	4 (*b*)
Total	113,860		1,105,826		799,280		1,370,000		23

(*a*) December estimated; (*b*) decrease.

The rest of the world, particularly Europe, has to an extent recovered from the low production level to which it dropped during the war, although the output

outside of the United States in 1926 was not quite as large as in 1913. In contradistinction, the production of the United States has increased over 80 per cent since 1913, and today very largely, as in 1913 completely, coincides with domestic needs. Demand for American metal, which, leaving aside the war years, reached a peak in the winter of 1924-1925, declined practically to nil in the succeeding winter. High prices abroad had stimulated ore shipments and smelting operations, and the monthly supply of zinc ore to European smelters rose from an average of 100,000 tons in 1925 to 150,000 tons by the middle of 1926. Italy, Australia, the United States, and Mexico were the chief contributors to this increase. The result was an oversupply and a sharp marking up of treatment charges. In the meantime, some American metal continued to go abroad. On the whole, 1926 was a year of fairly good consumption there, and an improvement in export shipments developed during the late spring and summer, partly as a result of the cessation of smelting in Great Britain. Exports were, however, on a reduced scale; in 1926 export shipments averaged 3,500 tons per month, which represented about 6 per cent of the total United States production; in 1925 about 5,500 tons a month was shipped, or an average of 11 per cent of the country's total production.

At the beginning of 1926 stocks were low, some 9,300 tons, and the prices fairly high, over 8½c., East St. Louis basis. Production, however, tended to increase more rapidly than consumption, despite an increase in the latter which carried the first quarter's domestic shipments ahead of the excellent last quarter of 1925 and up to a figure not reached again in 1926 until the late fall. By the end of May stocks on hand had doubled, and the East St. Louis price for Prime Western had declined to about 6.80c. Beginning with June production was curtailed and coincidently consumption began to pick up, with the result that for the third quarter an average price of 7.40c. was realized and stocks fell to approximately what they were at the beginning of the year. In August production again began to increase and in November reached a rate only slightly below that of February, the last high month. Domestic deliveries also continued to increase and broke all records in November. Marketwise, however, zinc proved uneventful, with a slight downward tendency, the year closing with the price about 7c. Contributory to this were no doubt the fact that a full production had again been reached in the face of a lack of forward orders, an uncertain outlook abroad, and a general disposition to look for less industrial activity in 1927 than in 1926. Broadly speaking, the price range of about 1½c. during 1926 was of moderate proportions.

Of the zinc-consuming industries all have shared in the general activity, the brass trade standing out as breaking all peace-time records and absorbing a large part of the increased production of high-grade metal. Buying of zinc has shared the prevalent hand-to-mouth policy, and the year has closed with both producers and consumers lightly stocked. Smelter stocks amount to less than two weeks' domestic requirements.

Between the present market situation and that of a year ago there are several points of difference. Then sentiment was generally optimistic and, in respect to the amount of zinc consumed during the year, quite justified; from the amount of zinc produced not so justified, considering the price level reached before increased production made itself felt. In other words, in establishing in January, 1926, the highest price reached since the peak of the post-war boom in January, 1920, the price of the metal had already discounted the record-breaking consumption foreseen and over-optimistically provided for during 1926. Today sentiment is more conservative, and there is no widely felt incentive to increase production; Europe appears quite able to manage without American zinc and is in fact believed by some to be producing too much of her own; stocks here, while low, are ample and the price of zinc is one and a half cents below that of a year ago and within a quarter of a cent of the year's low. Perhaps in the current price the outlook is already discounted, just as it was a year ago.

Yearly Average Prices of Principal Metals, 1895-1926

Prices in New York or St. Louis, cents per pound, except quicksilver (dollars per flask); silver and platinum (dollars per ounce). London quotations, pounds sterling per long ton.

	Copper		Lead		Tin		Zinc			Anti-mony,	Quick-silver,	Silver,	Plat-inum,
Year	Electrolytic New York	Standard London	New York	London	(f) New York	(a) London	New York	St. Louis	London	New York	New York	New York	New York
1895	10.76(b)	.....	3.23	.....	14.05	63.333	3.63	.....	.....	7.560	39.58	65.250	.....
1896	10.88(b)	.....	2.98	.....	13.29	59.496	3.94	.....	.....	6.650	37.00	67.060	.....
1897	11.29(b)	.....	3.58	12.367	13.67	61.400	4.12	.....	.....	6.750	38.50	59.790	.....
1898	12.03(b)	.....	3.78	12.983	15.70	71.204	4.57	.....	.....	8.690	40.70	58.260	.....
1899	16.67	.....	4.47	14.933	25.12	122.429	5.75	.....	.....	9.430	43.63	59.580	15.22
1900	16.19	.....	4.37	16.987	29.90	133.575	4.39	.....	.....	9.500	51.00	61.330	18.09
1901	16.11	.....	4.33	12.521	26.74	118.633	4.07	.....	.....	8.250	47.00	58.950	20.00
1902	11.626	52.460	4.069	11.262	26.79	120.720	4.84	.....	.....	6.120	48.03	52.160	19.00
1903	13.235	57.970	4.237	11.579	28.09	127.320	5.40	5.191	.....	6.000	41.32	53.570	18.91
1904	12.823	58.884	4.309	11.983	27.99	126.733	5.100	4.931	.....	6.371	41.00	57.221	19.50
1905	15.590	69.465	4.707	13.719	31.358	143.083	5.882	5.730	25.433	10.250	38.50	60.352	20.34
1906	19.278	87.282	5.657	17.370	39.819	180.646	6.198	6.048	27.020	21.730	40.90	66.791	28.04
1907	20.004	87.007	5.325	19.034	38.166	172.638	5.962	5.812	23.771	14.840	41.50	65.237	30.98
1908	13.208	59.902	4.200	13.439	29.465	133.124	4.726	4.578	20.163	8.004	44.84	52.864	16.32
1909	12.982	58.732	4.273	13.042	29.725	134.774	5.503	5.352	22.185	7.466	46.30	51.502	24.87
1910	12.738	57.054	4.446	12.920	34.123	155.308	5.520	5.370	23.050	7.386	47.06	53.486	32.70
1911	12.376	55.973	4.420	13.970	42.281	192.353	5.758	5.608	25.281	7.540	46.54	53.340	43.12
1912	16.341	72.942	4.471	17.929	46.096	209.420	6.943	6.795	26.421	7.760	42.46	60.835	45.55
1913	15.269	68.335	4.370	18.743	44.252	201.679	5.648	5.504	22.746	7.520	39.54	59.791	44.88
1914	13.602	61.524(c)	3.862	19.076(c)	34.301	156.564(c)	5.213	5.061	22.544(c)	8.763	48.31	54.811	45.14
1915	17.275	72.532	4.673	22.917	38.590	163.960	13.230	13.054	67.533	30.280	87.01	49.684	47.13
1916	27.202	116.059	6.858	31.359	43.480	182.096	12.804	12.634	72.071	25.370	125.49	65.661	83.40
1917	27.180	124.892	8.787	30.500	61.802	237.563	8.901	8.730	52.413	20.690	106.30	81.417	102.82
1918	24.628(d)	115.530	7.413	30.100	(e)	330.138	8.159	7.890	54.180	12.581	123.47	96.771	105.95
1919	18.691	90.796	5.759	28.590	63.328	257.601	7.338	6.988	42.879	8.190	92.15	111.122	114.61
1920	17.456	97.480	7.957	37.832	48.273	295.866	(e)	7.671	44.372	8.485	81.12	100.900	110.90
1921	12.502	69.356	4.545	22.752	28.576	165.265	(e)	4.655	25.845	4.957	45.46	62.654	75.03
1922	13.382	62.123	5.734	24.097	31.831	159.450	(e)	5.716	30.003	5.471	58.946	67.521	97.618
1923	14.421	65.840	7.267	27.147	41.799	202.148	(e)	6.607	33.058	7.897	66.502	64.873	116.537
1924	13.024	63.149	8.097	34.421	49.674	248.737	(e)	6.344	33.728	10.836	69.761	66.781	118.817
1925	14.042	61.920	9.020	36.429	56.790	260.974	(e)	7.622	36.624	17.494	83.128	69.065	119.093
1926	13.795	57.971	8.417	31.075	63.615	291.016	(e)	7.337	34.105	15.988	91.903	62.107	113.269

(a) Prices of tin, London, from 1895 to 1914 from statistical report of Metallgesellschaft, Frankfurt-am-Main. (b) Prices 1895 to 1898 are for Lake copper. (c) Average for nine months, no quotations being made during August, September and October. (d) Average of eleven months, no quotations being made in December. (e) No average computed. (f) 99 per cent tin.

WORLD GOLD *Production Slightly Lower*

Transvaal Makes New Record—United States Declines

By H. N. Lawrie
Managing Director, American Gold and Silver Institute, Washington, D. C.

THE WORLD'S GOLD PRODUCTION in 1926 is estimated at $388,500,000, a decline of $1,000,000 from the revised estimate of 1925. Through the co-operation of the Bureau of Foreign and Domestic Commerce, cabled estimates were obtained from a large number of the principal producing countries, and this year it was possible also to obtain through the Soviet Information Bureau a cabled estimate from Moscow of the 1926 Russian production.

Under favorable labor conditions, the Transvaal in 1925 produced 9,598,000 oz. of gold, valued at $198,408,000, which was a record year. Under still more favorable labor conditions, the production of gold in the Transvaal in 1926 is estimated at 9,960,000 oz., valued at $205,891,000, or an increase of 362,000 oz., valued at $7,483,000, which establishes a new high record. In Mexico the production of gold declined from $16,310,000 in 1925 to $12,821,000 in 1926, or a decline of $3,489,000. The production of refinery gold in continental United States declined from $47,957,000 in 1925 to $45,268,000 in 1926, or a decline of $2,689,000. Russian production, in accordance with the best estimates obtainable, is about the same as last year, $17,500,000, with a probable increase of $500,000 with more complete returns. The production of the Province of Ontario, Canada, it is estimated, will exceed $31,000,000, indicating an increase over last year of more than $1,500,000. The incomplete returns from the Yukon and western Canada indicate declines, but the production for the Dominion this year should not be less than $36,250,000, an increase of approximately $500,000 over that of last year. These are the principal changes in production, there being only minor variations from last year indicated in the productions of other countries.

The refinery production of gold in the United States (including the Philippine Islands), as estimated by the U. S. Mint in co-operation with the U. S. Bureau of Mines, amounted to $47,299,000 in 1926, a decline of $2,561,200 from the production in 1925. This is the lowest production since 1915, when the highest production was recorded, of $101,035,700. Production of gold in California in 1926 amounted to $11,574,400, a decline of $1,693,800 from that of 1925; in Colorado, $6,859,300, a decline of $521,300; in Montana, $1,248,800, a decline of $488,100; in Nevada, $3,505,900, a decline of $222,300; in South Dakota, $5,932,000, a decline of $24,800; in Utah, $3,681,200, a decline of $63,900; in Arizona, $4,759,200, an increase of $532,400; in Alaska, $6,467,300, an increase of $240,700; and in the Philippine Islands, $2,031,200, an increase of $128,000.

The United States produced 21.5 per cent of the world's highest production in 1915, $468,799,812, and has since contributed a continually decreasing percentage, until in 1924 it was 13.4 per cent; in 1925, 12.8 per cent; and in 1926, only 12.2 per cent. Canadian prospects for increased production in the near future are good, and unless some constructive assistance be rendered the domestic producers of gold, the production in Canada will probably overshadow that in the United States in the not distant future.

The purchasing power of the 1913 dollar for the first eleven months of 1925 was 63.0c., increasing to 66.1c. in the corresponding period of 1926. Notwithstanding the apparent decrease in the cost of production resulting from a deflation of commodity prices, domestic production of gold continued to decline. This indicates further that reserves are becoming depleted and that even though a deflation in commodity prices should continue in 1927, the production may still further decline. It is true that monetary demands for gold in foreign countries are becoming increasingly great, and as it becomes more difficult to satisfy these demands, a world-wide deflation will probably result. The impending deflation, however, will probably not involve serious price declines, extending, as it probably will, over a long number of years.

Imports of gold into the United States increased from $121,057,168 in the first eleven months of 1925 to $196,500,366 during the corresponding period of 1926, an increase of $75,443,198, while for the same period the exports declined from $256,672,063 in 1925 to $108,511,537 in 1926, a decline of $148,160,526. In the first eleven months of 1925 there was an excess of exports amounting to $135,614,895 and for the same period in 1926 an excess of imports of $87,988,829. This sudden and extensive change in the movement of gold has occasioned no little concern to our financial authorities in preventing inflationary influences. The deflation in commodity prices which actually occurred in 1926 is an evidence of the success which our financial authorities met in this regard.

U. S. Refinery Production of Gold and Silver in 1926 (a)

(Arrivals at United States Mints and Assay Offices and at Private Refineries)

State	Gold		Silver	
	Ounces	Value	Ounces	Value
Alaska	312,856	$6,467,300	641,080	$400,034
Arizona	230,227	4,759,200	7,507,798	4,684,866
California	559,911	11,574,400	1,974,556	1,232,123
Colorado	331,819	6,859,300	4,637,114	2,893,559
Georgia	101	2,100	10	6
Idaho	12,181	251,800	7,556,764	4,715,421
Illinois	.....	.....	3,150	1,966
Michigan	.....	.....	110,022	68,654
Missouri	.....	.....	70,508	43,997
Montana	60,411	1,248,800	12,498,246	7,798,906
Nevada	169,598	3,505,900	6,313,622	3,939,700
New Mexico	25,513	527,400	538,966	336,315
North Carolina	97	2,000	20	13
Oregon	12,631	261,100	27,412	17,105
Pennsylvania	19	400	544	340
South Dakota	286,960	5,932,000	83,120	51,867
South Carolina	14	300	.....	.....
Tennessee	421	8,700	106,344	66,359
Texas	111	2,300	449,985	280,791
Utah	178,078	3,681,200	19,299,533	12,042,909
Vermont	.....	.....	1,750	1,092
Virginia	10	200	.....	.....
Washington	8,872	183,400	163,678	102,135
Philippine Islands	98,259	2,031,200	44,778	27,942
Totals	2,288,089	$47,299,000	62,029,000	$38,706,100

(a) Data from Bureau of the Mint in Co-operation with the Bureau of Mines. Silver valued at 62.4c. per ounce, the average New York price of bar silver.

It is not probable that South Africa will be able long to continue production at the present rate, and the world's gold production in the future must depend very largely upon production in the Transvaal, unless new discoveries should be made. In view of the present limited monetary gold reserve in the world, and the prospects of a supply of new gold no greater than at present, currency and financial authorities are concentrating on the problem of developing economies in the monetary use of the metal, and thus the gold standard is now being subjected to the severest test in its long and not uneventful history.

SILVER *Undergoes Change in Position*

Trade Revival in India and Peace in China Should Improve Price

By Arthur B. Parsons
Assistant Editor, *Engineering and Mining Journal*

ON OCT. 19, 1926, silver in New York sold for 51½c., the lowest price touched since Nov. 20, 1915. As late as Aug. 27 the price was 63c., and not until Sept. 24 was the 60c. level passed. These figures reveal a precipitous drop of 8½c. in about three weeks. Since then the price has recovered somewhat, the average for December being 53.466c. The average for the months of May, June, and July was 65.116c.; that for October, November, and December was 54.036c., or about 11c. lower. As the range for each of these three-month periods was comparatively narrow, the averages fairly reflect a decided change in position. The reasons for this decline virtually constitute the market story for silver during 1926. The principal causes are: (a) Increased production, (b) internal strife in China, and (c) the report of the Royal Commission on Indian Currency and Finance.

Production—Compared with the aggregate output of new metal for the year, or with the stocks in India or Shanghai, an increase of 4¼ million ounces in production during the year is of only minor importance. The silver market differs from that of copper, lead, or zinc in that only a small proportion of the metal is "consumed." Most of it goes into great reservoirs, from which it may again emerge for sale in quantities far eclipsing in size fluctuations in mine production.

The break in the market in October was expected to result in a decline of some consequence in the rate of output. To date, however, no signs of a net reduction are evident. At the same time, it is quite possible that a continuation of a 54c. market is likely to result in curtailment or shutting down in various regions. Output for 1926 established a new high record at about 246,000,000 oz.

Situation in China—In the opinion of well-informed observers the most important element in the collapse of silver is the internal troubles in China. Table II shows the stocks at Shanghai on Dec. 1, including sycee, bars, and dollars, to be equivalent to 132 million ounces, the largest on record by a good margin. Stagnation of business in the interior decreases requirements of traders who are accustomed to buy silk, cotton, and other commodities from producers with spot payment in silver; likewise much of the so-called hoarded silver has gravitated to Shanghai and other cities for safe keeping. As indicated in Table III aggregate shipments from London and San Francisco were in as large volume in 1926 as in 1925, although San Francisco's share has increased considerably. These conditions, with the publication of the report of the Indian Currency Commission, created a situation where the Chinese speculators —who are probably the biggest single factor in the world's silver market—found it advantageous to take the bearish side of the market. This of course aggrevated the position, and when the French Government threw 10,000,000 oz. on the market a sharp decline ensued. So far as the speculative feature is concerned, a change for the better may take place at any time; but so long as China is in turmoil its influence on the silver market is likely to be bad.

Report of the Indian Currency Commission—The obvious effects of the proposals of the Royal Commission on Indian Currency and Finance would be unfavorable rather than favorable to the market for silver; so that the natural consequence of the publication of the commission's conclusions was immediately to create a pessimistic sentiment which was followed by a depression in price. More mature study of the proposals brings to light the fact that very ingenious safeguards have been devised for the purpose of mitigating bad effects on the silver market. Moreover, it appears likely that custom and habit of the Indian people will operate to prevent some of the dire consequences that have been foreseen.

Heretofore India's finances have been based on a "gold-exchange standard." Currency has consisted of silver

Table I—World's Production of Silver*

In Troy Ounces

Source	1922	1923	1924	1925	1926
United States....	56,240,049	66,163,338	64,221,655	61,377,977	62,000,000
Canada.....	18,626,439	18,601,744	20,243,846	20,003,970	22,000,000
Mexico.....	81,076,899	90,810,855	91,437,944	92,885,176	94,000,000
Peru.....	13,169,765	18,645,362	18,800,000	21,253,000	20,000,000
Rest of world....	41,420,351	45,821,715	46,232,244	46,054,971	48,000,000
Total.....	210,533,502	240,052,014	240,935,689	241,575,094	246,000,000

*Figures prior to 1926 from American Bureau of Metal Statistics; those for 1926 estimated from the Bureau's figures and other data.

Table II—Approximate Stocks of Silver at Various Dates

In Troy Ounces

	Shanghai	India	United States	Canada
Jan. 1, 1923.....	51,000,000	297,000,000	814,246	682,389
Jan. 1, 1924.....	45,000,000	297,000,000	345,982	429,210
Jan. 1, 1925.....	87,000,000	277,000,000	1,060,212	674,850
Jan. 1, 1926.....	101,000,000	286,000,000	365,000	634,000
Dec. 1, 1926.....	132,000,000	362,000,000	242,000	1,085,000

Table III—Silver Shipments to China and India

	To China		
	1924	1925	Eleven Months 1926
From New York, oz.....	.....	.....	.....
From San Francisco, oz.....	34,617,000	42,573,000	52,542,000
From London, value.....	£368,000	£927,000	£329,000
	To India		
	1924	1925	Eleven Months 1926
From New York, oz.....	81,180,000	67,648,000	66,728,000
From San Francisco, oz.....	636,000	.....	.....
From London, value.....	£4,446,000	£5,012,000	£6,276,000

rupees and paper notes redeemable in rupees. Neither is convertible into gold. The value of these in relation to gold has been maintained by purchases and sales of foreign exchange. This system gave reasonable satisfaction until the war, when it became clear that a revision was needed. Under the proposed plan both silver coins and notes are convertible into gold in minimum lots of 400 oz., thereby establishing what is known as a "gold-bullion standard" as distinguished from a true gold standard. Paper notes no longer are convertible "by law" into silver coin. Provision is made for the sale by the Indian Government of portions of its huge reserve of silver above specified maxima during a period of ten years commencing with 1929.

The two provisions that cause most apprehension among silver producers are (1) non-convertibility of paper notes into silver rupees; and (2) sale of silver by the Indian Government. Various American economists have estimated the quantity as being between the outside limits of 250 and 700 million ounces during the ten-year period.

In connection with these two matters Joseph Kitchin, a member of the Royal Commission, has written several letters that are reassuring in some measure to the silver producer. It appears that: (1) The Currency Authority is to be relieved of the legal obligation to redeem notes in silver simply to guard against the possibility of the price of silver exceeding 104c. per ounce, the level above which the silver rupee is worth more as bullion than its nominal value as money. Normally, however, notes and silver (both legal tender) will be in circulation interchangeably; and coins must be provided in whatever quantity the people desire them. In view of the inherited predilection of India's hundreds of millions for "hard" money, this provision of the proposed law seems to be of technical rather than practical importance. (2) There may be no actual sale of silver by the Indian Government, or, if there is, it may be on a far smaller scale than anticipated in America. For one thing, any large increase in the note issue is not to be expected for some years, because the gold reserve is not adequate and cannot be increased rapidly. Consequently, silver coins will be required to meet current business needs. Probably the most important factor will be the degree of prosperity enjoyed by interior India for the next five or six years. If crops and trade are continuously good the present excessive supply of rupees in the reserve may be absorbed gradually by current demands of business, and the need of sales by the treasury will be avoided in a large measure at least. Moreover, it seems that it would be highly inexpedient for the Indian Government to press silver on a declining market and weaken the confidence of the people of India in the metal that they recognize as a dependable measure of value. The Indian Government will not be a buyer of silver, but for that matter it has not been for six years past. It may become a seller, but certainly not until 1929 and perhaps, even then, to a much less extent than is feared.

A fair statement of the outlook for 1927 seems to be that a sustained improvement in the silver market depends on a revival of trade in India, thereby stimulating demand on private account; a composing of the situation in China; favorable results from the campaign to increase consumption in the industrial arts and in European coinage; and some reduction in world output.

IRON AND STEEL *Show Increased Production*

Petroleum Fields, Railroads, and Building Industries Absorb Larger Tonnage

By B. E. V. Luty
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FROM 1925 to 1926 there was an increase of 8 per cent in pig-iron production and an increase of 7 per cent in steel-ingot production. Even with this increase, pig-iron production in 1926 failed to make a new record, falling short of that of 1923 by 2 per cent. Steel-ingot production had made a new record in 1925 by about 1 per cent, and thus, in steel-ingot production, 1926 made a new record by a fair margin.

Divergence between pig-iron and steel-ingot production arises from the fact that for many years demand for rolled steel has increased much more than has demand for steel and iron castings and rolled iron. Wrought-iron manufacture has decreased to almost negligible proportions, production in 1926 having probably been less than three-quarters of a million tons.

It is doubtful whether production of iron castings has increased by as much as one-fourth in the last twenty years. Considering increases in three classes of iron-foundry products, cast-iron pipe, sanitary ware, and radiators, it is evident that production of all other iron castings decreased. Production of steel castings increased quite moderately, reaching a million tons in 1913, but in 1925 production was only one and a quarter million tons, and it is not certain that 1926 brought any increase.

Thus, rolled steel has become by far the major part of the general iron and steel industry, and on account of the divergence between it and the remainder of the general iron industry, greater activity and prosperity are shown by the steel industry proper than by the iron and steel industry considered as a whole. The steel industry had large profits in 1926, running under those of only a few years; and, in contrast, the merchant blast furnaces had a poor year, with tonnage unsatisfactory and profits light. Lake Superior iron-ore shipments were about 60,000,000 tons, running under those of five other years, and profits on the relatively small tonnage that was actually sold in the open market were by no means large.

Increase in steel tonnage in recent years has been fairly large compared with increases in some manufacturing lines, but it has been small compared with increases that occurred both before and during the war. From the earliest period through 1906, pig-iron production doubled on an average every ten years, whereas since that time the increase has been much slower.

Steel production, starting much later, increased still more rapidly through 1913. There was a large further increase during the war, but afterward it was not until 1925 that the highest steel-ingot production during the war was exceeded. The 1926 production was only 55 per cent above the production of 1912 and 1913.

Production of steel ingots in 1926 was approximately 47,150,000 long tons, indicating about 34,500,000 long tons of finished rolled steel. The difference is accounted for in scrap and scale made in rolling, subsequently reclaimed by the blast furnace and open-hearth furnace.

Outstanding features of recent times in steel are steadiness in demand, increasing efficiency in consumption, and steadiness of prices. The steel trade has dropped its old habit of having intensive buying movements, with price rises and far-forward engagements, alternated by periods of recession and recuperation. The last old-style buying movement ended early in 1923. Since then hand-to-mouth buying, with increasing closeness, has been the practice of all consumers as well as of jobbers, there being necessarily exceptions in the case of steel required in large construction jobs. This hand-to-mouth buying, in numerous small orders, lends itself to price steadiness. Mills have little incentive to cut prices on the individual order while buyers are content to pay what are clearly going market values. In the principal lines there were no price fluctuations of importance during 1926, except for somewhat wide swings in sheets. The general average of steel prices had scarcely any perceptible change from the middle of 1925 to the end of 1926, and economies in production slightly increased average profits per ton.

There has been on the whole a great increase in efficiency since 1920 in the consumption of steel that is made into things of final use. Methods and equipment have greatly improved, and labor has become more painstaking and skilled. The result is that year by year a ton of steel has been consumed or utilized with less effort. Accordingly, the steel tonnage can increase while apparently there is less general trade activity. This augurs well for increasing tonnage in future, without exceptional industrial and business activity. Late in 1926 the volume of steel buying decreased somewhat, in a manner not accounted for by the time of year, suggesting that 1927 might be less active, but the difference may easily be made up when more detailed reports are recorded.

There has been no uniform increase in demand in the respective classes of steel, or in demand from the respective classes of consumers. Though there was less demand for oil-country tubular goods in 1925 than in 1924 or 1923, the 1926 demand was much above that of any previous year. Railroad absorption of steel increased from 1925 to 1926, but with a decrease in freight car buying. Building absorbed slightly more steel in 1926 than in 1925, and there was more plate work, in large pipe, in tanks, and in Lake vessels. Tin plate had a slight gain, largely on account of heavier exports late in the year, arising from the British coal strike, which interfered with South Wales production.

TIN *Establishes Itself on Higher Level*

Stocks Are Further Depleted

By J. H. Lang
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TENDENCY of the tin market to continually establish itself on higher levels, noted for several years past, persisted in 1926. Prices were as follows:

	Spot Straits New York, Cents per Pound	Spot Standard London Per Ton (long)
Opened	63¼	£290
High (Nov. 29) (a)	72½	£321
Low (June 7)	58¼	£261½
Closed	66¾	£300¼

(a) The high price in London was made Oct. 15, 1926.

It will be seen from this table that in New York the price range was as follows:

1926	58¼ to 72½c. per lb.
1925	50½ to 64½c. per lb.
1924	40 to 59c. per lb.
1923	37 to 51c. per lb.
1922	28¾ to 39c. per lb.

The generally accepted explanation or justification for this advance lies in the continual depletion of stocks which has gone on during this period—that is, from about 50,000 tons at the beginning of 1922 to less than a third of that quantity at the end of 1926, as shown in the accompanying table.

So far as supplies, 1926 vs. 1925, are concerned, the decrease in Straits and the increase in Banka, which about offset one another, are said to be due to a lesser smelting of Banka ores in the Straits Settlements. Actual production is supposed to have been about unchanged. Smaller shipments of Chinese tin are attributed to disturbed political conditions in that country. The increase in Standard is more apparent than real. There is an output of about 40,000 tons per annum from various countries (about three-fourths of it from Bolivia) classifiable as Standard, and latest returns show no increase from these sources worth mentioning. Perhaps when complete statistics from all over the world are obtainable there may be shown a small increase in mine production, but so far as the foregoing figures are concerned this item is without significance.

Tin Supplies, Deliveries, in Tons (long)—1926 vs. 1925

Supplies	1926	1925	Increase	Decrease
Straits shipments	76,474	78,952	.....	2,478
Australian	1,333	1,186	147	.....
Banka	16,445	14,177	2,268	.....
Chinese	3,022	7,421	.....	4,399
Standard	20,229	17,928	2,301	.....
Totals	117,503	119,664	.....	2,161
Deliveries				
United Kingdom	14,890	18,977	.....	4,087
Continent	20,461	21,175	.....	714
Total Europe	35,351	40,152	.....	4,801
Other countries	5,800	10,121	.....	4,321
	41,151	50,273	.....	9,122
United States	78,050	76,455	1,595	.....
Totals	119,201	126,728	.....	7,527
Visible supply Jan. 1	18,024	25,088	.....	7,064
Visible supply Dec. 31	16,326	18,024	.....	1,698
Decrease	1,698	7,064	.....	5,366

It will be observed that only about half the Standard supplies (and, of course, deliveries) appear in statistics. Whether a little more or less gets in from one cause or another is a matter of indifference. The important thing is the mine production.

Deliveries of tin increased 2 per cent in the United States and decreased 20 per cent in the rest of the world in 1926. Why the latter should have occurred is not altogether clear. The coal strike in England probably accounts for the decrease there, but developments on the Continent pointed to larger rather than smaller deliveries. Also, why the rest of the world outside of Europe and the United States should have cut its demand nearly in half is not clear. High prices may not affect consumption in the United States, but perhaps they are affecting it adversely elsewhere. The one thing that is clear is that these lesser takings by the rest of the world enabled the United States to acquire the tin it needed at much lower prices than would otherwise have been possible. In this connection it may be useful to compare 1926 with the last pre-war year of 1913, as in the accompanying table.

Tin Supplies, Deliveries, in Tons (long)—1926 vs. 1913

Supplies	1926	1913	Increases	Decreases
Straits shipments	76,474	62,467	14,007	.....
Australian shipments	1,333	3,300	.....	1,967
Banka shipments	16,445	17,142	.....	697
Chinese shipments	3,022	9,953	13,298	.....
Standard shipments	20,229			
Total shipments	117,503	92,862	24,641	.....
Deliveries				
United Kingdom	14,890	18,192	.....	3,302
Continent	26,261	25,870	391	.....
	41,151	44,062	.....	2,911
United States	78,050	45,448	32,602	.....
Total	119,201	89,510	29,691	.....
Visible supply Jan. 1	18,024	12,121	5,903	.....
Visible supply Dec. 31	16,326	15,473	753	.....
Increase	.....	3,352	5,150	.....
Decrease	1,698	.....	.....	.....
Opening price three months' standard London		£281-10	£229-10	
Closing price three months' standard London		£294-12/6	£169-5	

The table of supplies and deliveries shows that though supplies have increased 26 per cent in thirteen years, deliveries have increased 33 per cent, brought about by an increase of 70 per cent in the United States and a decrease of 7 per cent in the rest of the world.

It is apparent from the above that we must either produce more tin or use less. That constant efforts are being made, under the spur of high prices, to curtail consumption we all know, and apparently with some success outside of the United States. It is fair to assume that equally strenuous efforts are being made to increase production, succeeding to the extent of about 2 per cent per annum. What the eventual future may bring forth is unknown, but so far as 1927 is concerned it would not seem prudent to bank on any great change in this respect. The time is too short. All reviews and forecasts at the end of the year have laid stress on the increased stability of business in the United States. Because of our better banking system, the integration of our leading industries, the greater efficiency of transportation, and other features, it seems uniformly agreed that the period of alternating booms and panics, of hectic prosperity and hard times, is definitely behind us. The general business curve in 1926 showed a variation of only five points between the high and the low. In 1925 the variation was twelve points; in 1924 it was twenty-two points.

The outlook for 1927 is that business will continue in this orderly fashion, and therefore, though we may not use much if any more tin, we will use very little if any less.

A reasoned conclusion from the foregoing is that during the coming year tin will maintain a very close balance between supply and demand, with the market showing great sensitiveness to any disturbance of that balance. Any such disturbance is sure to result in extreme price fluctuations. While even slight variations in the United States, or at sources of supply, may produce such fluctuations, the center of interest really seems to have shifted for the time being at least to other countries. If they can continue to get along in 1927 with less tin than they used in 1913, we may see no great change in the situation, otherwise it is charged with infinite possibilities.

Copper Production of Important Countries

Based on blister, referred to country of origin

From data compiled by the American Bureau of Metal Statistics
Tons of 2,000 lb.

Country	1916*a*	1922	1923	1924	1925	1926*b*
United States	971,123	511,970	754,000	819,000	854,000	984,000
Mexico	60,751	29,842	60,538	57,139	59,123	42,600
Canada	52,880	25,300	40,230	50,072	56,239	33,700
Cuba	8,613	11,788	11,963	12,742	13,128	.....
Bolivia	5,675	10,154	11,744	8,200	7,500	.....
Chile	78,559	142,830	201,042	208,964	209,654	256,000
Peru	47,452	40,133	48,684	38,798	41,180	
Venezuela	1,300	1,075	1,175	1,230	1,500	.....
Europe	105,434	86,950	115,492	120,618	130,957	104,000
Asia	110,900	60,825	66,227	71,300	77,013	77,000
Australasia	43,920	13,754	19,995	15,711	13,800	10,500
Africa	43,876	58,219	80,410	115,300	118,180	90,000
Other countries	3,307	3,307	3,307	4,409	4,409	52,200
World's total	1,533,810	996,147	1,414,807	1,523,483	1,586,683	1,650,000

a War peak of production in United States was in 1916. War peak of world production was in 1917, the total being 1,580,475 tons.
b 1926 figures, partly estimated; figures for individual countries not comparable with figures for other years, as blister copper is not segregated according to countries of origin.

Shapes of Copper Shipped in 1926

By Percentages

	Domestic	Export	Total
Wire bars	63	71	66
Ingot bars	5	11	8
Ingots	8		5
Cakes	13	7	11
Cathodes	7	4	6
Bessemer	..	5	2
Other shapes	3	1	2

Primary Copper Production by U. S. Mines, and Foreign Supply to U. S. Smelters

American Bureau of Metal Statistics, in Tons of 2,000 Pounds

	1924	1925	1926
Porphyry mines	315,351	320,151	345,838
Lake mines	68,828	78,013	87,116
Vein mines	369,347	400,199	395,260
Custom ores	39,668	43,754	44,104
Total crude production	793,194	842,117	872,318
Imports in ore, matte, etc	76,139	81,665	(*a*)74,000
Blister produced from scrap	4,621	12,567	19,961
Total supply	873,954	936,349	966,279
Smelter production	898,464	947,333	984,135

(*a*) Imports for December estimated.

World Production of Aluminum

As Reported by the Metallgesellschaft, in Metric Tons

	1913	1921	1922	1923	1924	1925
United States	20,900	24,500	33,600	58,500	68,300	62,000
Canada	5,900	8,000	10,000	10,000	8,000	8,000
France	14,500	8,400	12,000	17,000	18,500	20,000
England	7,600	7,000	5,000	8,000	12,000	15,000
Norway	1,500		4,900	13,300	22,000	22,000
Italy	800		800	1,500	2,000	1,800
Switzerland				15,000	20,000	22,000
Germany	12,000	27,000	30,000	15,900	18,700	26,200
German Austria				1,500	2,200	3,000
Totals	63,200	74,900	96,300	140,700	171,700	180,000

Important Mining Stocks in 1926

Company	Exch.	High		Low		Last	Net Change	Sales
COPPER								
Anaconda	N. Y.	51⅞ Au. 6		41½ Mh. 30		48	—2⅛	1,297,500
Arcadian	B.	1⅝ Au. 4		*25 Mh. 27		*45	—17	30,761
Ariz. Com'l	B.	12⅛ Ja. 2		9¼ My. 25		9⅜	—3	57,662
Calaveras	N. C.	4 Ja.		1 Au.		2⅜	—⅛	40,200
Cal. & Ariz.	N. Y.	73⅝ Au. 9		55½ Mh. 29		66¼	+6	145,200
Cal. & Hecla	B.	18⅝ Au. 9		13½ Je. 7		14⅛	+⅜	124,421
Cerro de Pasco	N. Y.	73½ Au. 9		57½ Ja. 22		62	—⅜	549,600
Chile Copper	N. Y.	36⅜ Ja. 6		30 Mh. 3		34½	—⅞	461,300
Chino	N. Y.	26 No. 4		16 Mh. 3		25⅛	+6⅛	14,100
Con. Cop. M	N. C.	3⅜ My.		1⅛ Ap.		2⅜	+⅞	354,700
Copper Range	B.	20 Ja. 4		13 My. 20		14½	—4⅜	61,764
Crystal Cop.	B. C.	*60 Fe.		*25 My.		*30	—26	.....
East Butte	B.	4 Fe. 3		2¼ Oc. 13		2⅝	—1⅜	43,707
First National	B. C.	*80 Au.		*17 Mh.		*20	+10	.....
Franklin	B.	1½ Ja. 20		*25 No. 3		*30	—25	2,882
Granby	N. Y.	36⅝ De. 9		16½ Mh. 31		34½	+15	626,800
Greene-Can	N. Y.	34⅜ De. 14		9⅜ Ap. 3		31½	+19⅛	267,800
Hancock	B.	1¼ Jy. 17		*27 De. 20		*37	—43	2,787
Howe Sound	N. Y.	45 Se. 15		27 Ja. 8		40	+12½	515,900
Inspiration	N. Y.	28⅝ No. 10		20⅜ Mh. 30		25⅛	+⅜	195,200
Iron Cap	B. C.	4½ Jy.		1⅜ Ja.		2⅝	+⅜	.....
Isle Royale	B.	14 Au. 9		9⅜ Je. 7		10⅛	—1⅛	18,830
Jerome Verde	N. C.	1⅜ Fe.		*25 De.		*30	—64	60,400
Kennecott	N. Y.	64½ No. 16		49¾ Mh. 30		62	+7	2,344,700
Lake Copper	B.	1⅜ Jy. 14		*60 Oc. 26		*99	—1	6,849
Magma Cop	N. Y.	44⅞ Fe. 10		34 Ap. 19		35	—8	234,700
Mason Valley	N. C.	2⅝ Se.		1⅛ Ja.		2⅛	+⅛	56,500
Mass Con	B.	*75 Jy. 19		*15 De. 3		*35	—15	9,972
Miami Cop	N. Y.	17⅜ Oc. 1		11 Mh. 3		16⅛	—4	443,600
Mohawk	B.	46 Oc. 18		30 Mh. 30		39	+6½	38,088
Mother Lode	N. Y.	7⅛ Fe. 8		4 No. 19		4⅛	—3	286,700
Nevada Con	N. Y.	16¼ No. 6		11⅝ Je. 1		14¾	+1⅜	684,700
New Cornelia	B.	24 Au. 9		18⅛ My. 19		22	+2⅛	53,027
Noranda	N. C.	24½ De.		12⅛ Mh.		24	+8⅜	382,300
North Butte	B.	3⅜ Se. 20		2 Ap. 13		3⅜	+1	74,675
Ohio Copper	N. C.	*75 Ja.		*35 No.		*45	—22	316,400
Old Dominion	B.	20 Jy. 17		13 De. 29		14	—3	21,293
Phelps Dodge	O. M.	140 Au.		117 Ja.		130	+6	.....
Quincy	B.	25 Jy. 16		15½ My. 24		17½	—4	28,711
Ray Con	N. Y.	16⅝ No. 18		10½ Mh. 3		15⅜	+3⅛	698,400
Ray Hercules	N. C.	*16½ De		*11⅞ Fe.		*16½	+8⅛	.....
St Mary's M. L.	B.	38⅛ Fe. 10		25 De. 27		25	—10⅛	24,855
Seneca Cop	N. Y.	10⅜ Ja. 4		2⅛ De. 31		2⅜	.....	98,600
Shannon	B.	*80 Ja. 5		*15 De. 24		*20	—35	33,210
Shattuck-D	B. C.	9⅜ Ap.		5⅛ De.		5⅜	.....	.....
Superior & B	B.	1 1/16 Mh. 1		*20 No. 30		*30	—45	24,817
Tenn. C. & C	N. Y.	16 Fe. 5		10⅜ De. 10		11	—3⅛	326,400
U. Verde Ex	N. C.	33 Fe.		23½ De.		24	—⅛	68,300
Utah Copper	N. Y.	116 No. 13		93 Ap. 1		111½	+13⅛	12,600
Utah M. & T	B.	2⅜ Ap. 9		⅛ Ja. 8		1	*+35	333,411
Victoria	B.	*75 Fe. 23		*40 My. 24		*75	+40	5,465
Walker	S. L.	1.65 Ja.		*42 My.		*76	—86	143,558
NICKEL-COPPER								
Inter. Nickel	N. Y.	46¼ Ja. 5		32⅜ Mh. 30		38⅜	—6⅞	1,943,900
Int. Nickel, pfd	N. Y.	104⅜ De. 29		101¼ Ja. 29		104⅛	+2⅛	3,300
LEAD								
Gladstone M	S.	*38 Fe.		*27½ Jy.		*29⅜	—1¼	161,100
National Lead	N. Y.	181 De. 17		138 Ap. 15		167	—5	116,700
Nat. Lead, pfd	N. Y.	120 My. 20		116 Ja. 16		117⅜	+1⅛	12,350
St. Joe Lead	N. Y.	48⅜ Fe. 10		36⅜ My. 11		41⅛	—4⅜	240,900
ZINC								
Am. Z. L. & S	N. Y.	12⅛ Fe. 4		5⅛ My. 19		8⅛	+⅜	110,100
A. Z. L. & S., pfd	N. Y.	54⅛ De. 10		20 My. 19		44⅛	+6⅛	224,400
Butte C. & Z	N. Y.	6⅛ Fe. 10		4 De. 23		4⅛	—1⅛	91,300
Butte & Sup	N. Y.	16⅛ Ja. 11		7⅛ My. 18		10⅜	—3⅛	174,400
Callahan Z. L	N. Y.	2⅝ Ja. 15		1⅛ Mh. 26		1⅛	—⅛	1,006,500
Consol L. & Z	St.	28 Mh.		16⅜ De.		16⅛	.....	.....
Eagle-Picher	C.	35 Ja.		26⅜ My.		27⅞	—6⅜	.....
Eagle-P, pfd	C.	113 My.		109 Au.		100	—10	.....
N. J. Zinc	N. C.	210 Ja.		178 Oc.		193⅜	—16⅛	362,970
United Zinc	N. C.	*55 De.		*40 My.		*55	+30	1,400
Yellow Pine	L. A.	*50 Fe. 24		*14⅛ De.		*17	—23	.....
GOLD								
Alaska Jun	N. Y.	2 Ja. 4		⅞ Oc. 22		1⅛	—⅜	52,300
Argonaut	T.	*67 Oc.		*16 Ja.		*53⅛	+37⅛	.....
Barry-Hol	T.	1 No.		*20 Ja.		*86	+60⅛	.....
Carson Hill	B.	*50 Ja. 2		*10 De. 30		*15	—26	14,060
C. W. Dome L	T.	*29⅜ Fe.		*14 My.		*18	—5½	.....
Cresson Con	N. C.	2⅜ Ja.		1⅜ Je.		2⅛	—⅛	46,600
Crown Res	T.	*24¼ Fe.		*8 Se.		*10⅛	—12⅛	.....
Dome	N. Y.	20 Mh. 13		8 Oc. 18		9⅜	—7⅛	357,300
Golden Ctr	N. C.	3 My.		1 Mh.		1⅜	—⅜	386,500
Hollinger	T.	21 De.		17.15 Mh.		20.40	+2.90	.....
Homestake	N. Y.	63 Oc. 9		47⅛ Ja. 4		61⅛	+13⅛	25,100
Kirkland L	T.	1.44 Fe.		*66 No.		*88	+3	.....
Lake Shore	T.	16 De.		9⅛ Mh.		15.70	+6.10	.....
McIntyre-P	N. Y.	30 Fe. 15		22¼ Oc. 14		25	+2⅛	78,600
Newray	T.	*45 Ja.		*32 Jy.		*35	—8	.....
Night Hawk P	T.	*17 Fe.		*3½ No.		*7	—3	.....
Rand Mines	N. Y.	41⅜ Oc. 1		32⅜ Ap. 30		39⅛	+5⅜	3,080
Teck-Hughes	T.	5.55 De.		2.71 Ja.		5.45	+2.82	.....
Tom Reed	L. A.	*75 Mh. 31		*35 No.		*51	—4	.....
Tough-Oakes	T.	*64½ No.		*36 Ap.		*60	+5	.....
Untd. Eastern	N. C.	*59 Se.		*30 Je.		*53	+8	92,400
Vipond Con	T.	2.02 Ja.		1.48 My.		1.68	*+7	.....
Wright-Harg	T.	10 De.		7.55 Mh.		9.90	+2.5	.....
Yukon-A, T	N. C.	23⅞ Ja.		20 Fe.		20⅛	—⅝	6,300
GOLD AND SILVER								
Beaver Con	T.	*99 Fe.		*51 Ja.		*67½	+16½	.....
Carnegie Met	P.	22⅞ Fe.		11½ No.		12	—6⅝	23,132
Con. Cortez	N. C.	*14 Au.		*3 Oc.		*12	+6	142,600
Con. Virginia	S. F.	*40 Ja. 2		*4 Je. 30		*6½	—31	.....
Continental	N. C.	*50 Fe.		*10 De.		*15	—60	4,100
Dolores Esp	N. C.	1 Ja.		*32 Au.		*50	—32	80,400
N. Y. & Hon. R.	N. C.	14 Fe.		11 Jy.		14	.....	500
Premier Gold	N. C.	2⅜ Mh.		1 1/16 De.		1⅛	—⅛	111,200
Tonopah Bel	N. C.	4⅜ Ja.		2⅜ De.		2⅜	0	124,200
Tonopah Ext	N. C.	1⅛ Ja.		*18 De.		*20	—105	306,700
Tonopah Mng	N. C.	7¼ Fe.		3⅛ Oc.		3⅛	—1⅛	88,600
Unity Gold	N. C.	*30 Jy.		*30 Jy.		*30	+10	2,000
West End Con	N. C.	*30 Fe.		*8 De.		*8	—17	77,000
Yukon Gold	N. C.	*74 Ja.		*20 Au.		*42	—9	21,300
SILVER								
Alvarado	N. C.	1 Ja.		1 Ja.		1	+*2	600
Can. Lorrain	T.	*93 Ja.		*45½ Oc.		*58¾	—15¼	.....
Castle-Treth	T.	1.84 Fe.		*96 Oc.		1.07	*—43	.....
Coniagas	T.	4.85 Au.		3 Je.		4.35	*—25	.....
Keeley	T.	1.91 Ja.		1.39 My.		1.51	*—16	.....
Kerr Lake	N. C.	1⅜ Fe.		*74 No.		*75	—25	100,000
La Rose	T.	*39 Ja.		*4 No.		*10	—29	.....
Lorrain T. L	T.	1.10 Ja.		*30 No.		*50	—60	.....
McKinley D. S.	T.	*26 Ja.		*8½ Oc.		*12½	—12½	.....
Mining Corp	T.	4.45 Fe.		2.60 Oc.		3.15	*—16	.....
Nipissing	N. C.	9⅛ De.		5 Je.		8⅜	+2	239,000
Temiskaming	T.	*15¼ Fe.		*6 Se.		*7½	—6½	.....
SILVER-LEAD								
Ahumada	N. Y.	9⅛ Ja. 4		4⅜ No. 22		5	—4	223,700
Alta Merger	S. L.	*3		*2		.....	.....	18,000
Bingham	B.	55⅜ Ja. 4		29 Je. 2		29½	—24	49,292
Cardiff	S. L.	*57 Mh.		*20 Oc.		*48	—7	60,590
Chief Con	S. L.	3.775 Ja.		2.60 No.		2.90	—0.90	16,034
Constitution	S.	*80		*24		*45	.....	1,000
Emma S	S. L.	*1¼ Ja.		*½		....	.....	101,000
Erupcion	B. C.	2⅛ Ja.		1 Oc.		1⅛	—1⅛	.....
Federal M. & S.	N. Y.	111⅜ Ja. 5		41 My. 22		88	—7½	33,950
Federal pfd	N. Y.	105 Ja. 6		61 Mh. 3		77	—22½	113,700
Hawthorne	N. C.	*32 Fe.		*6 No.		*11	—6	3,369,700
Hecla	N. C.	19⅛ Mh.		15⅛ Mh.		15⅜	—2¼	77,000
Highland-S	S.	*24½		*16¼		*16½	.....	128,430
Iron King	S. L.	*47 Se.		*13 No.		*20	—16	112,700
Keystone	S. L.	*64 Fe.		*20		*30	—33	64,100
Lucky Jim	S.	*19½ Je.		*13¾ Ja.		*16	+3½	251,100
Lucky T.-Com	K. C.	9⅝ Jy. 8		6.15 Oc. 13		6½	.....	.....
Mammoth	S. L.	3.05 Se.		2.50 De.		2.65	—0.15	28,315
Marsh	S.	*14¾ Ja.		*1⅞ De.		*2	—5½	499,376
Park Utah	N. Y.	8½ Fe. 5		5⅛ Se. 30		5⅞	.....	154,600
Plutus	S. L.	2.20 De.		*80		2½	.....	14,550
Prince Con	S. L.	*9 Ja.		*⅛ Au.		*1⅜	—7	489,564
Silver King C	S. L.	9.85 Ja.		6.90 Oc.		7.80	—1.75	58,801
Silversmith	S.	*51½ De.		*24½ De.		*25¾	—13¼	278,997
Strattons	S.	*54		*24½		*31	.....	94,112
Sunshine	S.	*42		*20		*38	.....	102,055
Tamarack-Cus	S.	*80 Ja.		*24 Oc.		*38½	+3½	216,320
Tintic Std	S. L.	14½ Au.		9⅜ Se.		11⅛	—2⅜	50,870
Utah-Apex	B.	11⅜ Fe. 5		4⅜ Oc. 26		5⅜	—1 7/16	293,023
Western Utah	N. C.	*8 Fe.		*5 Au.		*5	—5	9,000
IRON								
Bethlehem St	N. Y.	51⅛ Se. 20		37⅛ My. 20		46⅞	—1⅛	1,506,100
Cleveland-Cl	C.	82 Au. 11		69½ Ja. 5		75	+8	3,638
Colo. F. & I	N. Y.	49⅜ Oc. 2		27⅜ Mh. 3		43⅛	+6⅛	1,106,400
C. F. & I. pfd	N. Y.	112 My. 3		110 Ap. 28		110	+6	300
Gt. Nor. I. Ore	N. Y.	27⅛ Fe. 15		18 De. 10		19⅜	—6⅛	193,600
Inland Steel	N. Y.	43⅜ De. 20		34½ My. 11		42⅛	—⅜	129,300
Mesabi Iron	N. C.	2⅛ Ja.		*87 De.		*95	—55	41,900
Replogle Steel	N. Y.	15⅝ Ja. 4		8 Oc. 27		11⅞	—3⅜	5,266,400
Repub. I.&S.	N. Y.	63⅜ Ja. 7		44 My. 19		57⅛	—1⅜	530,900
Rep. I.&S. pfd	N. Y.	99 Se. 15		91⅛ Mh. 30		96⅞	+2⅞	22,100
Sloss-Sheffield	N. Y.	142½ Au. 10		103 Ap. 12		127	—8½	257,800
Sloss-Shef. pfd	N. Y.	110 Je. 29		100½ Ja. 18		105½	+2½	5,100
U.S. Steel	N. Y.	160½ De. 17		117 Ap. 15		157⅞	+21⅛	24,562,100
U.S. Steel pfd	N. Y.	130⅜ De. 29		124½ Mh. 3		130⅜	+4⅜	96,293
Va. I.C. & C.	N. Y.	60⅜ No. 11		40 My. 15		50	+7	18,600
V.I.C & C. pfd	N. Y.	85 De. 13		70 Jy. 19		80½	+3½	2,100
DIAMONDS								
DeBeers Con	N. Y.	39⅛ Oc. 4		27⅛ Ap. 20		32⅛	+3⅛	3,600
ALUMINUM								
Alum. Co. Am	N. C.	76 Ja.		54½ Ja.		71	+8	49,400
Alum. Co. pfd	N. C.	103¾ No.		98⅛ Ja.		102	+3	7,920
PLATINUM								
S. Am. G. & P	N. C.	5¾ Jy.		3⅛ No.		3⅜	— ⅛	146,600
TIN								
Patiño M. & E	N. C.	26½ De.		25⅛ De.		25½	.....	20,400
VANADIUM								
Vanadium Corp.	N Y	43 Au. 16		29 Mh. 3		39⅛	+8	252,150
ASBESTOS								
Asbestos Corp	M	25⅛ Oc. 29		16⅛ Au. 4		23½	.....	113,834
Asbestos pfd	M	87 De. 17		64 Ap. 1		85⅛	.....	83,131
SULPHUR								
Freeport Tex	N. Y.	36 De. 3		19⅜ Ja. 13		34	+13⅜	2,629,300
Texas Gulf	N. Y.	52⅜ No. 29		39 Oc. 25		49⅜	.....	2,026,700
MINING, SMELTING, REFINING, AND GENERAL								
Amer. Metal	N. Y.	57⅜ Fe. 16		42⅛ De. 23		42⅞	—11⅛	187,900
Am. Metal pfd	N. Y.	120 Fe. 6		113½ Ap. 15		112⅛	—3⅞	7,100
Amer. S. & R	N. Y.	152 Au. 17		109⅝ Ap. 21		142⅞	—1⅜	3,225,300
A. S. & R. pfd	N. Y.	122⅜ De. 20		112⅞ Mh. 31		120⅜	+6⅜	38,700
Consol. M. & S.	M	264½ De.		165		252	+71⅛	753,578
Fed. Metals	N. C.	22 Ja.		11 Oc.		12½	—5½	17,800
Newmont	N. C.	77 Oc.		46½ Ja.		73	+26	88,400
Southwest M	N. C.	1½ Fe.		*10 De.		*10	—240	4,100
U.S.S.R. & M	N. Y.	49⅞ Ja. 2		30 Oc. 23		36	—13⅜	173,400
U.S. Smg. pfd	N. Y.	50 Ja. 4		42 Oc. 22		47½	—1⅜	30,710

*Cents; N. Y., New York Stock Exchange; N. C., New York Curb Market; B., Boston Stock Exchange; B. C., Boston Curb; O. M., open market; S. L., Salt Lake; S., Spokane; St., St. Louis; C., Cincinnati; L. A., Los Angeles; S. F., San Francisco; K. C., Kansas City; M., Montreal; T., Standard Stock Exchange, Toronto; P., Pittsburgh.

Mining Dividends Paid in 1925 and 1926

North and South American Companies

Official data supplied by individual companies except when indicated by an asterisk(*), in which case it is from published reports.

Company, Metals Mined, and Class of Stock	Situation	Shares Outstanding	Par Value	1925 Per Share	1925 Total	1926 Per Share	1926 Total	Total Paid to End of 1926	Latest Dividend Paid to Dec. 31, 1926 Date	Per Share
United States										
*Aluminum Co. of A., pfd	Various	736,380	$100	.....	.....	$6.00	$4,418,280	?	Oct., 1926	$1.50
American Metal	Various	594,267	No	$3.25	$1,926,775	4.00	2,376,003	?	Dec., 1926	1.00
American Metal, pfd	Various	50,000	100	7.00	350,000	7.00	350,000	?	Dec., 1926	1.75
American Smelting & Refining	Various	609,980	100	6.25	3,812,375	7.25	4,422 355	$151,585,546	Nov., 1926	2.00
American S. & R., pfd	Various	500,000	100	7.00	3,500,000	7.00	3,500,000		Dec., 1926	1.75
*Anaconda Copper Mining	Various	3,000,000	50	3.00	9,000,000	3.00	9,000,000	193,958,750	Nov., 1926	0.75
Arizona Commercial	Ariz.	265,000	5	1.00	265,000	1.00	265,000	2,014,000	July, 1926	0.50
*Barnes King Development, g	Mont.	400,000	5	0.60	240,000	.....	.....	?	April, 1925	0.60
*Bethlehem Steel, pfd	Various	970,000	100	7.00	4,303,073	7.00	6,777,660	?	Oct., 1926	1.75
Betty O'Neal, s	Nev., Ariz.	465,460	5	0.10	43,380	0.45	206,381	366,607	Nov., 1926	0.05
*Bingham, s, l	Utah	50,000	10	2.50	167,375	3.00	150,000	992,375	Sept., 1926	1.00
Bunker Hill & Sullivan, l, s	Idaho	327,000	10	9.00	2,943,000	9.00	2,943,000	36,774,920	Dec., 1926	0.75
Bunker Hill & Sullivan, pfd	Idaho	5,247	100	6.50	16,210	9.00	38,710		Oct., 1926	2.25
Butte Copper & Zinc, z, l, s, m	Mont.	600,000	5	0.50	300,000	0.50	300,000	1,500,000	Dec., 1926	0.50
*Butte & Superior, z, c	Mont.	290,197	10	2.00	580,394	2.00	580,394	18,536,344	Dec., 1926	0.50
*California Rand Silver, s, g	Calif.	1,280,000	1	0.54	691,200	0.09	115,200	4,064,000	Sept., 1926	0.01
Calumet & Arizona, c, s, g	Ariz.	642,757	10	4.00	2,571,028	6.00	3,856,542	58,162,042	Dec., 1926	1.50
Calumet & Hecla Con. Copper	Mich.	2,005,502	25	1.50	3,008,253	1.50	3,008,253	8,022,008	Dec., 1926	0.50
Champion Copper	Mich.	100,000	25	11.40	1,140,000	5.00	500,000	29,570,261	Dec., 1926	5.00
Chief Consolidated, s, l	Utah	1,141,846	1	0.20	214,193	0.40	456,659	3,540,233	Nov., 1926	0.10
Cleveland-Cliffs Iron	Mich., Minn.	400,000	No	3.00	1,200,000	4.00	1,600 000	?	Oct. 1926	1.00
*Colorado Fuel & Iron, pfd	Colo., Wyo.	20,000	100	8.00	160,000	8.00	160,000	?	Nov., 1926	2.00
Consolidated Lead & Zinc	Kans., Okla.	200,000	No	.....	.....	2.00	400,000	400,000	Dec., 1926	0.125
Copper Range	Mich.	394,755	25	1.00	394,727	1.00	394,755	28,971,401	May, 1926	1.00
Cresson Con. Gold	Colo.	1,220,000	1	0.40	488,000	0.40	488,000	11,386,272	Oct., 1926	0.10
*Davis-Daly Copper	Mont.	600,000	10	0.80	480,000	.....	.....	1,380,000	Feb., 1925	0.80
Eagle-Picher Lead, l, z	Okla.	1,000,000	20	1.60	1,200,000	1.60	1,200,000	?	Dec., 1926	0.40
Eagle-Picher Lead, pfd	Okla.	8,513	100	6.00	51,480	6.00	51,186	?	Oct., 1926	1.50
Engels Copper	Calif.	2,877,563	1	0.13	371,470	0.075	215,817	1,285,972	Aug., 1926	0.005
*Federal Mng. & Smg., pfd., s, l, z	Ida., Mo., Kans.	120,000	100	7.00	839,034	21.00	2,520,000	22,022,871	Dec., 1926	1.75
General Development	Various	120,000	25	1.00	120,000	1.00	120,000	?	Nov., 1926	0.25
Gladstone Mountain, l	Wash.	1,321,890	0.10	0.05	66,094	0.07	92,532	158,627	Dec., 1926	0.005
Golden Cycle M. & R., g	Colo.	1,500,000	1	0.12	180,000	0.13	195,000	10,458,300	Dec., 1926	0.04
*Great Northern Iron Ore P	Minn.	1,500,000	No	1.75	2,625,000	1.50	2,250,000	57,000,000	Dec., 1926	0.75
Hecla Mining, l, s	Idaho	1,000,000	0.25	2.00	2,000,000	2.00	2,000,000	16,105,000	Dec., 1926	0.50
*Hercules Mining, l, s	Idaho	?	?	?	250,000	?	?	18,831,000	?	?
Homestake Mining, g	S. D.	251,160	100	7.00	1,758,120	7.00	1,758,120	50,647,834	Dec., 1926	0.50
Horn Silver, l, z	Utah	400,000	1	.....	.....	0.03	12,000	?	Oct., 1926	0.03
*Inland Steel	Minn.	1,182,799	No	2.50	2,956,998	2.625	3,104,846	?	Dec., 1926	0.625
*Inland Steel, pfd	Minn.	100,000	100	7.00	700,000	7.00	700,000	?	Oct., 1926	1.75
*Inspiration Con. Copper	Ariz.	1,181,967	20	1.00	1,181,967	2.00	2,363,934	44,893,536	Oct., 1926	0.50
Iron Cap Copper, pfd	Ariz.	18,573	10	.....	.....	0.45	6,981	1,060,189	Nov., 1926	0.15
Isle Royale Copper	Mich.	150,000	25	1.00	150,000	1.00	150,000	2,700,000	Dec., 1926	0.50
Jardine Mining, g, a	Mont.	2,184,380	1	0.01	21,844	0.005	10,922	32,766	Jan., 1926	0.005
Kennecott Copper	Alaska	4,496,603	No	3.00	13,044,699	4.00	17,898,691	106,275,484	Oct., 1926	1.00
Keystone Mining, l, s	Utah	900,000	1	0.075	67,500	0.075	67,500	135,500	Feb., 1926	0.075
Magma Copper, c, s	Ariz.	408,155	No	1.50	612,232	3.00	1,224,465	3,540,697	Oct., 1926	0.75
*Mammoth Mining, l, c, s, g	Utah	400,000	0.10	0.20	79,063	0.60	240,000	3,138,127	Dec., 1926	0.25
Miami Copper	Ariz.	747,116	5	1.25	933,892	1.125	840,505	30,701,969	Nov., 1926	0.375
*Mohawk Mining, c	Mich.	115,000	25	4.00	460,000	5.00	575,000	11,325,000	Dec., 1926	2.00
Mother Lode Coalition, c, s	Alaska	2,500,000	No	0.75	1,875,000	0.75	1,875,000	10,625,000	Dec., 1926	0.375
*National Lead	Various	206,554	100	8.00	1,652,432	8.00	1,652,432	?	Dec., 1926	2.00
*National Lead, pfd	Various	243,676	100	7.00	1,705,732	7.00	1,705,732	?	Dec., 1926	1.75
*Nevada Consol. Copper	Nevada	3,658,027	No	0.25	499,864	1.125	?	?	Dec., 1926	0.375
New Cornelia Copper	Ariz.	1,800,000	5	1.60	2,880,000	1.00	1,800,000	10,530,000	Nov., 1926	0.50
*New Jersey Zinc	Various	490,816	100	12.00	5,889,792	12.00	5,889,792	?	Dec., 1926	2.00
Newmont Mining, h	Various	431,200	10	1.60	558,000	2.40	1,032,600	1,590,600	Oct., 1926	0.60
Nichols Copper, pfd	N. Y.	22,956	100	7.00	161,847	7.00	160,989	?	Oct., 1926	1.75
*Night Hawk Leasing, c	Ariz.	?	?	0.50	?	1.00	?	?	Dec., 1926	0.25
Ohio Copper	Utah	2,981,800	1	0.05	149,090	0.03	89,454	387,314	Sept., 1926	0.03
*Park City Mng. & Smg., s, l, z	Utah	876,000	5	0.45	394,200	.....	.....	1,358,200	July, 1925	0.15
Park-Utah Consol., s, l, z	Utah	2,093,500	1	0.15	310,275	0.60	1,256,100	1,566,375	Oct., 1926	0.15
Phelps Dodge, c	Ariz., N. Mex., Mex.	500,000	100	4.00	2,000,000	5.00	2,500,000	109,046,527	Oct., 1926	1.50
Plutus Mining, g, s, l, z, c	Utah	999,545	0.10	.....	.....	0.30	299,863	299,863	Oct., 1926	0.15
*Portland Gold	Colo.	3,000,000	1	.....	.....	0.06	180,000	?	Oct., 1926	0.02
*Ray Consol. Copper	Ariz., N. M.	149,392	10	.....	.....	0.25	715,048	?	April, 1926	0.25
*Republic Iron & Steel	Mich., Ala.	300,000	100	.....	.....	2.00	600,000	?	Dec., 1926	1.00
*Republic Iron & Steel, pfd	Mich., Ala.	250,000	100	7.00	1,750,000	7.00	1,750,000	?	Oct., 1926	1.75
St. Joseph Lead, l, z	Mo., N. Y.	1,950,428	10	3.00	5,745,098	3.00	5,851,252	42,180,776	Dec., 1926	0.75
St. Mary's Mineral Land, c	Mich.	160,000	25	3.00	480,000	2.00	320,000	?	May, 1926	2.00
Sidney Mining, z, l, s	Idaho	1,500,000	1	.....	.....	0.00½	7,500	11,250	Nov., 1926	0.005
Silver King Coalition, s, l	Utah	1,216,100	5	1.00	1,216,100	1.10	1,337,710	9,205,545	Dec., 1926	0.10
*Sloss-Sheffield S. & I	Ala.	100,000	100	6.00	600,000	6.00	600,000	?	Dec., 1926	1.50
*Sloss-Sheffield S. & I., pfd	Ala.	67,000	100	7.00	469,000	7.00	469,000	?	Oct., 1926	1.75
*Superior Copper	Mich.	100,000	25	2.49	249,000	.....	.....	649,000	Feb., 1925	2.49
Tennessee Copper & Chem.	Tenn.	794,611	No	0.50	397,300	1.00	794,618	2,379,172	Dec., 1926	0.25
*Texas Gulf Sulphur	Texas	2,540,000	No	8.75	5,556,250	9.00	7,620,000	25,717,500	Dec., 1926	1.00
Tintic Standard, s, l	Utah	1,152,915	1	1.70	1,959,955	1.70	1,959,955	7,482,668	Dec., 1926	0.20
Tomboy Gold Mines	Colo.	310,000	£1	1s. 5d.	£22,193	1s. 7d.	£24,800	£ 907,618	Aug., 1926	9s. 6d.
*Tom Reed Gold	Ariz.	909,555	$1	$0.02	$18,191	$0.08	$72,764	?	Dec., 1926	$0.02
*Tonopah Extension, s, g	Nev.	1,477,716	1	0.10	143,522	.....	.....	$3,927,221	April, 1925	0.05
Tonopah Mining, s, g	Nev.	1,000,000	1	0.15	150,000	0.15	150,000	16,425,000	Oct., 1926	0.075
*Tonopah Belmont Dev., s, g	Nev.	1,500,000	1	0.10	150,000	.....	.....	10,943,063	Oct., 1925	0.05
*Tungsten Production	Colo.	3,200,000	1	.....	.....	0.02	64,000	?	June, 1926	0.02
Union Copper L. & M	Mich.	80,000	25	0.50	40,000	0.25	20,000	391,000	Nov., 1926	0.25
*United Gold Mines	Colo.	5,000,000	0.10	0.02	100,000	.....	.....	?	Aug., 1925	0.01
U. S. Smelting, Ref. & Mng., l, s	Various	351,115	50	2.25	790,009	3.50	1,228,902	52,428,678	Oct., 1926	0.875
U. S. Smelting, R. & M., pfd	Various	486,350	50	3.50	1,702,225	3.50	1,702,225		Oct., 1926	0.875
*U. S. Steel	Various	5,084,952	100	7.00	35,581,175	7.00	35,584,545	667,128,546	Dec., 1926	1.75
*U. S. Steel, pfd	Various	3,603,141	100	7.00	25,219,677	7.00	25,220,254	672,930,038	Nov., 1926	1.75
*United Verde Copper	Ariz.	300,000	No	6.00	1,800,000	8.00	2,400,000	70,912,500	Dec., 1926	3.00
United Verde Extension, c	Ariz.	1,050,000	0.50	2.25	2,362,500	3.00	3,150,000	27,405,000	Nov., 1926	0.75
*Utah Apex, l, c, s, g	Utah	528,200	5	1.30	686,660	1.20	689,610	2,595,500	Oct., 1926	0.25
*Utah Copper	Utah	1,624,490	10	4.25	6,904,082	5.25	8,528,542	147,248,441	Dec., 1926	1.50
*Vanadium Corp	Various	377,137	No	1.00	377,127	3.75	1,414,264	3,483,072	Dec., 1926	1.00
*Virginia Iron, C. & C., pfd	Va., Ky.	50,000	100	5.00	250,000	5.00	250,000	?	July, 1926	2.50
*Yellow Pine, z, l	Nev.	1,000,000	1	0.16	160,000	.....	.....	3,020,000	Dec., 1925	0.04
Foreign										
Ahumada Lead, l, s	Mex.	1,192,018	$1	1.00	1,192,018	0.90	1,072,816	3,097,997	Oct., 1926	0.25
Amparo Mining, g, s	Mex.	2,000,000	1	0.10	200,000	0.08	160,000	5,092,177	Nov., 1926	0.02
*Araca, Emp. de Fst., t	Bolivia	200,000	£1	13s.	£130,000	8s.	£80,000	?	?	?
*Aramayo Mines, s, t, b, c	Bolivia	840,000	25 Sw.fr.	5 fr.	4,200,000 fr.	5 fr.	4,200,000 fr.	?	Nov., 1926	1.25 fr.

Mining Dividends in 1925 and 1926—(Concluded)

Company, Metals Mined, and Class of Stock	Situation	Shares Outstanding	Par Value	1925 Per Share	1925 Total	1926 Per Share	1926 Total	Total Paid to End of 1926	Latest Dividend Paid to Dec. 31, 1926 Date		Per Share
Foreign—Concluded											
*Asbestos Corp.	Quebec	20,000	No	$5.50	$165,000	$1.50	$45,000	?	Jan.,	1926	$1.50
*Asbestos Corp., pfd.	Quebec	74,561	$100	6.00	240,000	5.00	320,964	?	Oct.,	1926	1.75
*Belmont Surf Inlet, g.	B. C.	2,500,000	1	0.125	312,500	0.175	437,500	1,437,500	Dec.,	1926	0.025
*British Platinum & Gold.	Colombia	596,614	£1	6d.	£14,915	.....	.....	?	Feb.,	1925	6d.
Camp Bird, pfd., g, s.	Colo.	649,625	1	.....	.....	7s. 8d.	£25,010	£2,452,477	Oct.,	1926	9 3/5d.
*Castle Trethewey, pfd., s.	Ont.	Now redeemed	.....	$0.035	$7,000	.....	.....	$18,027	April	1925	$0.035
*Cerro de Pasco Copper, c, s.	Peru	1,122,842	No	5.00	5,614,060	$4.00	$4,491,368	?	Nov.,	1926	1.00
*Cerro Grande, Est. de, t.	Bolivia	200,000	£1	.....	.....	3s.	£30,000	£30,000	?		?
Chile Copper	Chile	4,391,330	$25	2.50	10,977,987	$2.50	$10,978,325	$43,842,762	Dec.,	1926	$0.625
*Consolidated M. & S., c, l, z, s.	B. C.	507,356	25	1.50	755,751	9.50	4,819,882	?	July,	1926	3.75
Dome Mines, g.	Ont.	953,334	No	2.00	1,906,668	2.00	1,906,668	10,832,088	Oct.,	1926	0.50
Erupcion Mining, l, s.	Mex.	1,250,000	1	0.65	812,500	0.40	500,000	2,406,250	Oct.,	1926	0.10
Frontino & Bolivia Gold.	Colombia	140,000	£1	9d.	£5,250	9d.	£5,250	?	July,	1926	6d.
Frontino & Bolivia, pfd.	Colombia	23,390	1	2s.	2,339	2s.	2,339	?	July,	1926	1s.
*Great National Mexican S., c.	Mex.	10,000	$100	$107.50	$1,075,000	$20	$200,000	?	May,	1926	$20
Hollinger Consol. Gold.	Ont.	4,920,000	5	0.89	4,378,800	1.18	5,805,600	30,566,400	Dec.,	1926	0.10
Howe Sound c, l, s.	Mex., B. C.	496,038	No	0.10	198,415	3.00	1,488,114	3,273,849	Oct.,	1926	1.00
*Huanuni, Min. Porvenir.	Bolivia	425,000	£1	2s.	£42,500	2s.	£42,500	£85,000		?	?
*International Nickel, n, c.	Ont.	1,673,384	$25	$1.00	$1,673,384	$2.00	$3,346,768	?	Dec.,	1926	0.50
*International Nickel, pfd.	Ont.	89,126	100	6.00	534,756	6.00	534,756	?	Nov.,	1926	1.50
Keeley Silver.	Ont.	2,000 000	1	0.24	480,000	0.24	480,000	$1,760,000	Sept.,	1926	0.12
Kerr Lake, s.	Ont.	600,000	4	0.25	150,000	0.25	150 000	10,335,000	Oct.,	1926	0.125
Lake Shore, g.	Ont.	2,000,000	1	0.30	600,000	0.50	1,000,000	2,620,000	Dec.,	1926	0.20
Lorrain Trout Lake, s.	Ont.	1,500,000	1	0.10	150,000	.....	.....	150,000	July,	1925	0.05
Lucky Tiger-Combination, g, s.	Mex.	715,337	10	1.11	794,024	1.05	751,104	12,112,110	Dec,	1926	0.12
McIntyre Porcupine, g.	Ont.	798,000	5	1.00	798,000	1.00	798,000	6,005,408	Dec.,	1926	0.25
*Mexico Mines of El Oro, g, s.	Mex.	210,000	£1	4.s. 6d.	£47,250	2s. 3d.	£23,625	?	Dec.,	1926	9d.
Mining Corp. of Canada, s.	Ont.	1,660,050	$5	$0.125	$207,506	$0.25	$415,012	6,121,394	July,	1926	0.125
*Mond Nickel, c, n.	Ont.	900,000	£1	2s. 6d.	£112,500	1s.	£45,000	?	Mar.	1926	1s.
*Mond Nickel, pfd.	Ont.	2,000,000	1	1s. 4.8d.	280,000	1s.4.8d.	280,000	?	Sept.,	1926	8 4d.
*Morocorala, Soc. Est., t.	Bolivia	500,000	1	3s.	75,000	2s.	50,000	£125,000	?		?
*Nacional de Plomo.	?	40,000	$30	$5.00	$200,000	$5.00	$200,000	$500,000	?		?
N. Y. & Honduras Rosario, s, g.	Honduras	200,000	10	1.75	350,000	2.00	400,000	7,350,000	Oct.,	1926	$0.50
Nipissing, s.	Ont.	1,200,000	5	0.75	900,000	0.60	720,000	28,140,000	Oct.,	1926	0.15
*Oploca, Min. y Agric.	Bolivia	500,000	£1	10s.	£250,000	5s.	£125,000	?	?		?
*Oruro, Minera de.	Bolivia	3,000,000	B 13½	B 2¾	B8,000,000	B 1½	B4,000,000	?	?		?
Patiño Mines & Ent., t.	Bolivia	1,380,316	$20	13s.	£897,205	14s.	£966,221	£2,208,504	Nov.,	1926	5s.
Premier Gold, s, g.	B. C.	5,000,000	1	$0.34	$1,700,000	$0.32	$1,600,000	$9,350,000	Oct.,	1926	$0.08
St. John del Rey, g.	Brazil	546,265	£1	2s.	£54,627	.....	.....	?	June,	1925	1s. 3d.
St. John del Rey, pfd.	Brazil	100,000	1	1s.	5,000	1s. 8d.	£8,333	?	May,	1926	1s. 8d.
San Francisco Mines, l, z, s, g.	Mex.	1,503,959	10s.	3s. 9d.	281,992	1s. 6d.	112,796	£751,834	June,	1926	1s. 6d.
Santa Gertrudis, g, s.	Mex.	1,503,400	£1	.....	.....	1s. 9d.	131,488	1,142 827	Oct.,	1926	9d.
Santa Gertrudis, notes.	Mex.	900 (7%)	200	£17	23,380	£7	6,993	131,219	July,	1926	£7
*Silversmith, s, l, z.	B. C.	2,500,000	$0.20	$0.05	$125,000	$0.08	$200,000	$725,000	Oct.,	1926	$0.02
Teck-Hughes Gold.	Ont.	4,747,144	1	.....	.....	0.10	474,714	474,714	Aug.,	1926	0.05
*Tocopila, Min.	?	400,000	£1	3s.	£60,000	2½s.	£50,000	?	?		?
Whitewater, pfd., l, s.	B. C.	100,000	$1	.....	.....	$0.25	$25,000	675,000	Oct.,	1926	0.15
Wright-Hargreaves, g.	Ont.	2,750,000	1	$0.25	$687,500	0.375	1,031,250	2,681,250	Oct.,	1926	0.075

g, gold; s, silver; l, lead; z, zinc; m, manganese; c, copper; a, arsenic; h, holding company; t, tin; b, bismuth; n, nickel.

Mining Directory

Professional Organizations

American Association of Petroleum Geologists, Box 1852, Tulsa, Okla.

American Chemical Society, 1709 G St., N. W., Washington, D. C.

American Electrochemical Society, Columbia University, New York.

American Institute of Mining and Metallurgical Engineers, 29 West 39th St., New York.

American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa.

Australasian Institute of Mining and Metallurgy, 48 Queen St., Melbourne, Victoria, Australia.

Canadian Institute of Mining and Metallurgy, Drummond Building, Montreal, Quebec, Canada.

Chemical, Metallurgical and Mining Society of South Africa, 100 Fox St., Johannesburg, Transvaal, South Africa.

China Institution of Mining and Metallurgy, 13 K' Vei Chia Ch' Ang; Peking, China.

Geological Society of America, Museum of Natural History, Columbus Ave. and 77th St., New York.

Geological Society of London, Burlington House, London W., England.

Geological Society of Washington, U. S. Geological Survey, Washington, D. C.

Institution of Mining and Metallurgy, 225 City Road, London E. C. 1, England.

Mining and Metallurgical Society of America, 2 Rector St., New York.

Society of Chemical Industry, Central House, Finsbury Square, London, E. C. 2, England; Pratt Institute, Brooklyn, New York.

Society of Economic Geologists, 42 Broadway, New York.

Mining—Educational Institutions

United States

Alabama—Mine Experiment Station, University of Alabama, University, Ala.; ————, Director.

Alaska—Alaska Agricultural College and School of Mines, College, Alaska; Charles E. Bunnell, President.

Arizona—College of Mines and Engineering, University of Arizona, Tucson, Ariz.; G. M. Butler, Dean.

California—College of Mining, University of California, Berkeley, Calif.; Frank H. Probert, Dean.
Department of Mining and Metallurgy, Stanford University, Calif.; Theodore J. Hoover, Dean.

Colorado—Colorado School of Mines, Golden, Colo.; Melville F. Coolbaugh, President.

Connecticut—Department of Mining and Metallurgy, Yale University, New Haven, Conn.; C. H. Mathewson, Professor of Metallurgy, and R. K. Warner and H. A. Behre, assistant professors of mining.

Idaho—School of Mines, University of Idaho, Moscow, Idaho; Francis A. Thomson, Dean.

Illinois—Mining Engineering Department, University of Illinois, Urbana, Ill.; A. C. Callen, Head.

Iowa—Mining Engineering Department, Iowa State College, Ames, Iowa; Prof. A. K. Friedrich, Head.

Kansas—Department of Mining Engineering, University of Kansas, Lawrence, Kan.; Prof. C. M. Young, Head.

Kentucky—Department of Mines and Metallurgy, University of Kentucky, Lexington, Ky.; C. J. Norwood, Head and Professor of Mining.

Massachusetts—Department of Mining, Metallurgy and Geology, Massachusetts Institute of Technology, Cambridge, Mass.; Prof. Waldemar Lindgren, Head; Department of Mining, Harvard University, Cambridge, Mass. D. H. McLaughlin, Professor of Mining.

Michigan—Michigan College of Mines, Houghton, Mich.; Wm. O. Hotchkiss, President.

Minnesota—School of Mines, University of Minnesota, Minneapolis, Minn.; W. R. Appleby, Dean.

Missouri—Missouri School of Mines and Metallurgy, Rolla, Mo.; Dr. Charles H. Fulton, Director.

Montana—Montana State School of Mines, Butte, Mont.; G. W. Craven, President.

Nevada—Mackay School of Mines, University of Nevada, Reno, Nev.; John A. Fulton, Director.
Virginia City School of Mines, Virginia City, Nev.; J. P. Gilbreth, Director.

New Jersey—School of Engineering, Princeton University, Princeton, N. J.; Arthur M. Greene, Jr., Dean.

New Mexico—New Mexico School of Mines, Socorro, N. M.; E. H. Wells, President.

New York—School of Mines, Columbia University, New York, N. Y.; E. J. Hall, Executive Officer.
Department of Geology, Cornell University, Ithaca, N. Y.; Prof. H. Ries, Head.

North Dakota—College of Engineering and School of Mines, University of North Dakota, Grand Forks, N. D.; E. F. Chandler, Dean.

Ohio—Department of Metallurgical and Mining Engineering, Case School of Applied Science, Cleveland, Ohio; Herbert M. Boylston, Professor. Department of Mine Engineering, Ohio State University, Columbus, Ohio; H. E. Nold, Professor.

Oklahoma—College of Engineering, University of Oklahoma, Norman, Okla.; J. H. Felgar, Dean.
Oklahoma School of Mines and Metallurgy, Wilburton, Okla.; E. E. Tourtellotte, President.

Oregon—School of Mines, Oregon Agricultural College, Corvallis, Ore.; Charles E. Newton, Dean.

Pennsylvania—Department of Mining and Metallurgy, Carnegie Institute of Technology, Schenley Park, Pittsburgh, Pa.; James Aston, Professor and Head of Department. Department of Mining Engineering, Lehigh University, Bethlehem, Pa.; Prof. Howard Eckfeldt, Head. Department of Mining Engineering, Lafayette College, Easton, Pa.; W. B. Plank, Head. School of Mines, University of Pittsburgh, Pa.; F. L. Bishop, Dean. School of Mines and Metallurgy, Pennsylvania State College, State College, Pa.; E. A. Holbrook, Dean.
South Dakota—South Dakota State School of Mines, Rapid City, S. D.; C. C. O'Harra, President.
Texas—College of Mines and Metallurgy, University of Texas, El Paso, Tex.; John W. Kidd, Dean.
Utah—Schools of Mines and Engineering, University of Utah, Salt Lake City, Utah; Dr. Joseph F. Merrill, Director.
Virginia—Department of Mining Engineering, Virginia Polytechnic Institute, Blacksburg, Va.; Prof. O. C. Burkhart, Head.
Washington—College of Mines, University of Washington, Seattle, Wash., Milnor Roberts, Dean. School of Mines and Geology. State College of Washington, Pullman, Wash.; ————, Dean.
West Virginia—Department of Mining Engineering, West Virginia University, Morgantown, W. Va.; Prof. C. E. Lawall, Head of Mining Engineering Dept. and Director of Mining Extension Dept.
Wisconsin—Department of Mining and Metallurgy, University of Wisconsin, Madison, Wis.; Prof. R. S. McCaffery, Chairman. Wisconsin Mining School, Platteville, Wis.; H. B. Morrow, Director.
Wyoming—Department of Mining Engineering, University of Wyoming, Laramie, Wyo.; Prof. Joseph R. Guitéras, Head.

Canada

McGill University, Montreal, Que.
Nova Scotia Technical College, Halifax, N. S.
Queen's University, Kingston, Ont.
University of Alberta, Edmonton, Alberta.
University of British Columbia, Vancouver, B. C.
University of Toronto, Queen's Park, Toronto, Ont.

Mexico

Escuelas de Ingenieros, Mérida, Yucatan.
Escuelas de Ingenieros, Morélia, Michoacan.
Escuela Nacional de Maestros, Zacatecas, Zacatecas.
Colegio de Estato, Guanajuato, Guanajuato.
Ingenieros Agrónimos, Leon, Guanajuato.
Instituto Juarez, Villahermosa, Tabasco.
Universidad Nacional de Mexico, Mexico, D. F.
Instituto Geológico, Mexico, D. F.

U. S. Bureau of Mines

Washington, D. C.—Director, Scott Turner.
Assistant to the Director, Joseph H. Hedges.
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Chief of Economics Branch and Head of Coal Division, C. P. White.
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Chief Engineer, Government Fuel Yards, George S. Pope.
Chief Clerk, John D. Secrest.
Pittsburgh, Pa.—Chief Chemist and Superintendent of Pittsburgh Station, Arno C. Fieldner.
Mine Safety Service:
Supervising Engineer, Emergency Section, D. J. Parker.
Supervising Engineer, Instruction Service, J. J. Forbes.
Senior Mining Engineer, J. W. Paul.

U. S. Geological Survey

Director, George Otis Smith.
Administrative Geologist, Julian D. Sears.
Chief Clerk, John J. Madigan.
Geologic Branch, Walter C. Mendenhall.
Alaskan Branch, Philip S. Smith.
Topographic Branch, C. H. Birdseye.
Water-Resources Branch, N. C. Grover.
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Publication Branch, Editor, Bernard H. Lane.

State Geologists and Engineers

Alabama—Prof. Eugene A. Smith, State Geologist, University of Alabama, University, Ala.
Arizona—Dr. G. M. Butler, Director Arizona Bureau of Mines and State Geologist; University of Arizona, Tucson, Ariz.
Arkansas—George C. Branner, State Geologist, Little Rock, Ark.; W. N. Wilkes, Commissioner of Mines, Manufactures, and Agriculture, Little Rock, Ark.
California—L. L. Root, State Mineralogist; State Mining Bureau, San Francisco.
Colorado—Prof. Russell D. George, State Geologist, University of Colorado, Boulder, Colo.
Connecticut—Dr. W. E. Britton, Superintendent, State Geological and Natural History Survey, Connecticut Agricultural Experiment Station, New Haven, Conn.
Florida—Herman Gunter, State Geologist, Florida State Geological Survey, Tallahassee, Fla.
Georgia—Prof. S. W. McCallie, State Geologist, Geological Survey of Georgia, Atlanta, Ga.
Idaho—Francis A. Thomson, Secretary, Bureau of Mines and Geology, and Dean, School of Mines.
Illinois—Dr. M. M. Leighton, Chief, State Geological Survey Division, Urbana, Ill.
Indiana—Prof. W. N. Logan, State Geologist, Department of Conservation, Division of Geology, Indianapolis, Ind.
Iowa—Prof. George F. Kay, Director, Iowa Geological Survey, Iowa City, Iowa.
Kansas—Dr. Raymond C. Moore, State Geologist, University of Kansas, Lawrence, Kan.
Kentucky—Dr. W. R. Jillson, Director and State Geologist, Kentucky Geological Survey, Frankfort, Ky.
Louisiana—Louisiana Geological Survey, Louisiana State University, Baton Rouge, La.
Maryland—Dr. Edward B. Mathews, State Geologist, Maryland Geological Survey, Johns Hopkins University, Baltimore, Md.
Michigan—R. A. Smith, State Geologist, Department of Conservation, Geological Survey Division, Lansing, Mich.
Minnesota—Prof. W. H. Emmons, Director, Minnesota Geological Survey, University of Minnesota, Minneapolis, Minn.
Mississippi—Dr. Ephraim Noble Lowe, State Geologist, Mississippi State Geological Survey, University, Miss.
Missouri—H. A. Buehler, State Geologist and Director, Bureau of Geology and Mines, Rolla, Mo.
Montana—Department of Geology, University of Montana, Missoula, Mont.; Prof. J. P. Rowe, Head; C. H. Clapp, Professor of Geology. State Bureau of Mines, Butte, Mont.; George W. Craven, Director.
Nevada—Andy J. Stinson, Inspector of Mines, Carson City, Nev.; State Mining Laboratory, University of Nevada, Reno, Nev.; Prof. W. S. Palmer, Director.
New Jersey—Dr. H. B. Kummel, Director and State Geologist, Department of Conservation and Development, Trenton, N. J.
New Mexico—Prof. R. W. Ellis, State Geologist, University of New Mexico, Albuquerque, N. M.
New York—C. A. Hartnagel, Assistant State Geologist, New York State Museum, University of the State of New York, Albany, N. Y.
North Carolina—Wade Phillips, Director N. C. Department of Conservation and Development, P. O. Box 406, Raleigh, N. C.
North Dakota—Dr. A. G. Leonard, State Geologist, State Geological Survey, University of North Dakota, University, N. D.
Ohio—Prof. J. A. Bownocker, State Geologist, Geological Survey of Ohio, Columbus, Ohio.
Oklahoma—Charles N. Gould, Director, Oklahoma Geological Survey, Norman, Okla.
Oregon—Mining Survey Office, School of Mines, Oregon Agricultural College, Corvallis, Ore.; Charles E. Newton, Director.
Pennsylvania—Dr. George H. Ashley, State Geologist, Topographic and Geological Survey, Harrisburg, Pa.
South Carolina—Prof. Stephen Taber, State Geologist, Columbia, S. C.
South Dakota—Dr. Freeman Ward, State Geologist, State Geological and Natural History Survey, University of South Dakota, Vermilion, S. D.
Tennessee————, State Geologist, Tennessee Geological Survey, Nashville, Tenn.
Texas—Dr. J. A. Udden, Director, Bureau of Economic Geology and Technology, University Station, Austin, Tex.
Utah—Prof. William Peterson, State Geologist, Agricultural College of Utah, Logan, Utah.
Vermont—Dr. George H. Perkins, State Geologist, Dean, University of Vermont, Burlington, Vt.
Virginia—Wilbur A. Nelson, State Geologist, Virginia Geological Survey, University of Virgina, Charlottesvlle, Va.
Washington—Harold E. Culver, Supervisor, Division of Geology, Department of Conservation and Development, Pullman, Wash.
West Virginia—Dr. I. C. White, State Geologist, West Virginia Geological Survey, Morgantown, W. Va.
Wisconsin—E. F. Bean, Director, Geological and Natural History Survey, Madison, Wis.
Wyoming—Albert B. Bartlett, State Geologist; Val B. Maghee, Oil and Gas Inspector, Cheyenne, Wyo.
Ontario, Canada—Alfred G. Burrows, Provincial Geologist, Toronto, Ont., Canada.

Trade Associations

General—American Bureau of Metal Statistics, 115 Broadway, New York; American Mining Congress, 841 Munsey Building, Washington, D. C.; Association of Arizona Mining Men, Phoenix, Ariz.; California Metal and Mineral Producers' Association, San Francisco; Chamber of Commerce and Mines, Douglas, Ariz.; Chamber of Mines and Oil, Los Angeles, Calif.; Idaho Mining Association, Mackay, Idaho; Montana Mining Men's Association, Helena, Mont.; National Metal Trades Association, Chicago, Ill.; Nevada Mine Operators' Association, Reno, Nev.; Northwest Mining Association, Spokane, Wash.
Copper—Copper and Brass Research Association, 25 Broadway, New York; Copper Export Association, 25 Broadway, New York.
Gold and Silver—American Gold and Silver Institute, H. N. Lawrie, Managing Director; 1001 Fifteenth St., Washington, D. C.
Graphite—Plumbago-Graphite Association, 17 State St., New York.
Gypsum—The Gypsum Industries, 844 Rush St., Chicago.
Iron and Steel—American Iron and Steel Institute, 40 Rector St., New York; American Pig Iron Association, Penton Building, Cleveland, Ohio; Association of American Steel Manufacturers, care of Carnegie Steel Co., Pittsburgh, Pa.; Lake Superior Iron Ore Association, Cleveland, Ohio.
Limestone, Lime—National Agstone Association, Hartman Building, Columbus, Ohio; National Agricultural Limestone Association, Columbus, Ohio; National Lime Association, 927 Fifteenth St., N. W., Washington, D. C.
Petroleum—American Petroleum Institute, 250 Park Ave., New York.
Phosphate Rock—Phosphate Export Association, 301 Produce Exchange Building, New York.
Portland Cement—Portland Cement Association, 347 Madison Ave., New York.
Refractories—American Refractories Institute, 2202 Oliver Building, Pittsburgh, Pa.
Sand and Gravel—National Sand and Gravel Association, Suite 434, Munsey Building, Washington, D. C.
Slate—National Slate Association, W. S. Hays, Secretary; 791 Drexel Building, Philadelphia, Pa.
Zinc—American Zinc Institute, Inc., 27 Cedar St., New York.

The Market Report

Metal Prices Easier

Some Improvement in Silver, But Zinc, Copper, and Lead Weaken

New York, Jan. 19, 1927—The week ending today has not been a good one for the non-ferrous metal markets. Except for silver, which has ranged above 55c. and closed at 55⅞c., prices are lower than they were last Thursday and the volume of business has, if anything, been below normal. Zinc suffered the largest decline, being available today at 6.45c. Copper, after signs of improvement, has been exceedingly dull for the last two days, and is obtainable at 13.25c. delivered in Connecticut. Lead and tin prices are fractionally lower.

Copper Back to 13.25c.

The spurt in copper which started a week ago, and looked encouraging last Friday and Saturday, was short lived. On Thursday more than half the business of the week was done, the prices ranging from 13.25c. to 13.35c. in the East, and 13.375c. at higher freight rate points. On Friday and Saturday Middle West business was done at 13.50c., one large order being placed at 13.55c., and 13.35c. and 13.375c. were done in the East. Since Saturday, however, a deadly dullness has pervaded the market, and to effect sales sellers cut their price to 13.25c. yesterday. Even at that transactions were few. Some are nominally at 13.375c. and declare that they are prepared to maintain this position. Foreign business in January has been exceptionally brisk, Germany being the leader, followed by Great Britain and France. In view of this, Copper Exporters, Inc., increased its price from 13.50c. to 13.625c. on Jan. 14, this being an approximate parity with the improved market in this country. Even after the advance a fair foreign business is reported. Business in the f.a.s. market has been done at figures ranging from 13.20c. to 13.30c., with the lower price prevailing today.

Lead Weakens a Bit

Business in the lead market in the week ending today has been only fairly good, and not equal to that of the week before. The American Smelting & Refining Co. has maintained its New York contract price at 7.65c., though the London market has declined in the last three days and is now below the low level of a week ago. The activity on last Thursday, which brought the price of spot lead above £28 again, proved of short duration. Offerings have been made at slight concessions from 7.65c., New York, though most of the business has been done at the fixed price. One odd lot was offered at 7⅛c. In the Middle West, the leading producers have reduced their prices slightly, first to 7.475c. early in the week, and then to 7.45c. on Monday. Other smaller sellers have offered small tonnages at about 2½ points below these prices, without arousing much interest. The chief buyers during the week have been cable manufacturers and corroders, with the latter paying $2 to $3 per ton premium for the special corroding grades that they require. Most of the sales have been either for prompt or early February shipment, consumers generally feeling that the price trend is still downward. If the actions of the market in the past are repeated, however, a minor reaction may be expected before long.

Zinc at 6.45c.

The week saw a decline of 30 points in Prime Western zinc, the price being lower than any reached during 1926. Absence of active buying on the part of galvanizers, with only a small curtailment in production, appears to account for the decline. Most of the business is for February and March, but some sellers are apparently not very bullish, as they are willing to commit themselves for future positions at the present low levels. High-Grade zinc is dull, with quotations largely nominal at 9c. delivered in the East.

Tin Quiet and Unchanged

Tin business has been very meager. A few consumers have bought small lots, and some traders have shifted positions a little, but there has been no real activity and the prices have moved within a narrow range. Today has seen a slight improvement, and prices

Daily Prices of Metals

Jan.	Copper	Tin		Lead		Zinc
	Electrolytic, N. Y.	99 Per Cent	Straits	N. Y.	St. L.	St. L.
13	13 05	65.25	67.00	7.65	7 45@7.475	6.725@6.75
14	13 10	65.25	67.00	7.65	7.45@7.475	6.70@6.75
15	13.125	65.25	67.00	7.65	7.45@7.475	6.675
17	13.10	65.50	67.25	7.65	7.45	6.625@6.70
18	13 025	65 00	66.375	7.625@7.65	7.425@7.45	6.525@6 55
19	13.025	64.75	66.375	7.625@7.65	7.425	6.45
Av.	13 071	65.167	66 833	7 646	7.450	6 631

Average prices for calendar week ending January 15, 1927, are: Copper, 13.046c.; 99 per cent tin, 65.188c.; Straits, 67.063c.; N. Y. lead, 7.650c.; St. L. lead, 7.467c.; zinc, 6.773c.; and silver, 55.208c.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; i.e., delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard.

Quotations for copper are for ordinary forms of wire bars, ingot bars, and cakes. For ingots an extra 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Jan.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
13	56⅜	57¼	63	299½	295½	28 1/16	28 5/16	31 13/16	31 11/16
14	56¼	56¾	62¾	299¾	294½	28 1/16	28 5/16	31¾	31⅝
17	55⅞	56½	62½	301¾	296⅜	27 13/16	28⅛	31⅝	31½
18	55½	56⅛	62½	299¾	294½	27½	27 13/16	31	30 15/16
19	55⅜	56	62¼	298	293¼	27⅜	27⅝	30½	30⅜

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Jan.	Sterling Exchange "Checks"	Silver		Gold London	Jan.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
13	4.84¾	55¾	25¾	84s11½d	17	4.84⅞	55⅞	25⅞	84s11½d
14	4.85	55¾	25⅞	84s11½d	18	4.84¾	55⅞	25 15/16	84s10d
15	4.84⅞	55⅜	25½	.....	19	4.84⅞	55⅞	25⅞	84s10¾d
					Avg.		55.750		

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

have been somewhat firmer in spite of the decline in London, which had been more than discounted in New York yesterday afternoon, the market today for spot Straits closing at about 66½c.

Silver Touches 55⅞c.

During the last week the New York quotation for silver has varied between 55⅜c. and 55¾c., this improvement being due chiefly to China buying, although India has lent some support to the market. Business is generally quiet and no definite tendency is apparent.

Mexican Dollars, (old Mexican pesos): Jan. 13th and 14th, 42¾c.; 15th, 42⅛c.; 17th, 18th, and 19th, 42⅜c.

Exchanges Firmer

The principal European exchanges have been steady and are now slightly above the levels of a week ago, for the most part. Closing cable quotations on Tuesday, Jan. 18, were as follows: francs, 3.98c.; lire, 4.325c., and marks, 23.72c. Canadian dollars, ¼ per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified. London prices are according to latest mail advices.

Aluminum—Aluminum Company of America reduced prices 1c. per lb. on all grades of aluminum on Jan. 15. New price, 26c. per lb. for 98 and 99 per cent.

Antimony—Per lb., duty paid, New York: Chinese brands, spot, 14@14¼c.; April prices about ⅛c. less; Cookson's "C" grade, spot, 17½c. Market quiet. Needle antimony nominally 8c. for lump and 10c. for powdered. White oxide, 16½c.

Bismuth—Per lb., New York, in ton lots, $2.70@$2.75. London, 10s.

Cadmium—Per lb., New York, 60c. London, 1s. 10½d.@1s. 11d. for American metal; 1s. 10d. for Australian metal.

Iridium—Per oz., $115@$120 for 98 @99 per cent sponge and powder. Quiet. London, £32½ in iridio-platinum; £17@£20 for sponge and powder. Nominal.

Nickel—Per lb., ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent grade). London, £170@£175 per long ton, according to quantity.

Osmium—Per oz., $55@$60. London, £16@£19.

Palladium—Per oz., $55@$60. Pure metal as a constituent of crude platinum, $52@$54 per oz. Weaker. London, £11@£12, nominal.

Platinum—Official price on refined metal, $110 per oz. Open market cash sales of large lots, $101@$102. Pure metal as a constituent of crude platinum, $99. Market very dull.

London, £23 per oz. for refined and £20½ for crude. Dull.

Quicksilver—Per 75-lb. flask, $101@$102 for spot, depending upon quantity. San Francisco wires $99.33, steady. London £17½@£17½.

Rhodium—Per oz., $55@$60; London, £10.

Ruthenium—Per oz., $45@$50; London, £7½.

The prices of Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Radium, Selenium, Tellurium, Thallium, Tungsten, and **Zircon** are unchanged from the issue of Jan. 8.

Metallic Ores

Manganese Ore—Per long ton unit of Mn, c.i.f. North Atlantic ports, minimum 47 per cent Mn, 36@38c. Caucasian (washed), 53@55 per cent, 38@40c. Chemical grades unchanged from Jan. 8 issue.

Tungsten Ore—Per unit of WO_3, N. Y.: Wolframite, $10.75@$11; Western scheelite,$11.25@$11.50. Market firm on small business.

Chrome, Iron, Molybdenum, Tantalum, Titanium, Uranium, and Vanadium Ores are unchanged from quotations in the Jan. 8 issue.

Zinc Blende Lower Again; Lead Ore Unchanged

Joplin, Mo., Jan. 15, 1927

Blende	
High	$49.80
Premium blende, basis 60 per cent zinc	$45.00@46.00
Prime Western, basis 60 per cent zinc	44.00
Fines and slimes, 60 per cent zinc	43.00@40.00
Average settling price, all zinc	45.21
Galena	
High	$100.00
Basis 80 per cent lead	95.00
Average settling price, all lead	97.62

Shipments for the week: Blende, 14,517; lead, 2,489 tons. Value, all ores the week, $900,450.

Some mines that cannot produce zinc ore for $44 per ton, basis of 60 per cent zinc, having no lead to mine in connection, are closing down and others are preparing to quit and remain idle until such time as the price will warrant resumption of operations. As a result the output is lowered to around 13,000 tons per week.

Lead stocks have been sold, some of the tonnage held for many months, down to about 2,000 tons. The present cessation of zinc output will not affect the lead output, as mines producing zinc only are closing down.

Platteville, Wis., Jan. 15, 1927

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$47.75
Lead Ore	
Lead, basis 80 per cent lead	$95.00

Shipments for the week: Blende, 1,413 tons; lead, none. Shipments for the year: Blende, 3,077; lead, 60 tons. Shipments for the week to separating plants, 2,459 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fullers Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, Tripoli, and **Zircon** are unchanged from prices in the Jan. 8 issue.

Mineral Products

Arsenious Oxide (White Arsenic)—3¼@3¾c. per lb. Quiet. London, £17 per long ton for 99 per cent Cornish white.

Calcium Molybdate, Copper Sulphate, Sodium Nitrate, Sodium Sulphate (Salt Cake), and **Zinc Oxide** are unchanged from prices in the Jan. 8 issue.

Ferro-Alloys

Ferromanganese—Domestic and foreign, 78@82 per cent, $100 per long ton, furnace or duty paid, for delivery during first half of 1927. Spiegeleisen, 19@21 per cent, $36@$37, f.o.b. furnace; 16@19 per cent, $34@$35.

Ferrocerium, Ferrochrome, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and **Ferrovanadium** are unchanged from prices in the Jan. 8 issue.

Metal Products

Rolled Copper—Sheets, 21¾c.; wire, 15½@15⅝c.; f.o.b. mill.

Lead Sheets—Full rolled, 11½c. per lb.; clipped, 11¾c.

Nickel Silver—28¾c. per lb. for 18 per cent nickel Grade A sheets.

Yellow (Muntz) Metal—Dimension sheets, 19½c. per lb.; rods 16½c.

Zinc Sheets—11c. per lb., f.o.b. mill.

Refractories

Silica Brick—Pennsylvania prices reduced to $40 per M. since the first of the year.

Chrome Brick, Fireclay Brick, Magnesite Brick, and **Zirkite** are unchanged from quotations in the Jan. 8 issue.

Steel Steady—Pig Iron and Coke Dull

Pittsburgh, Jan. 18, 1927

Another week of 1927 has added its testimony to the probability that the new year is bringing nothing new in trade, indicating that the recession of some three months ago was a decrease of importance and not the beginning of a mere year-end lull. In some lines increased buying is reported, but the instances are not particularly important. In sheets, for instance, the increase is from a low level. With the increase, the current demand is scarcely more than two-thirds of last year's average.

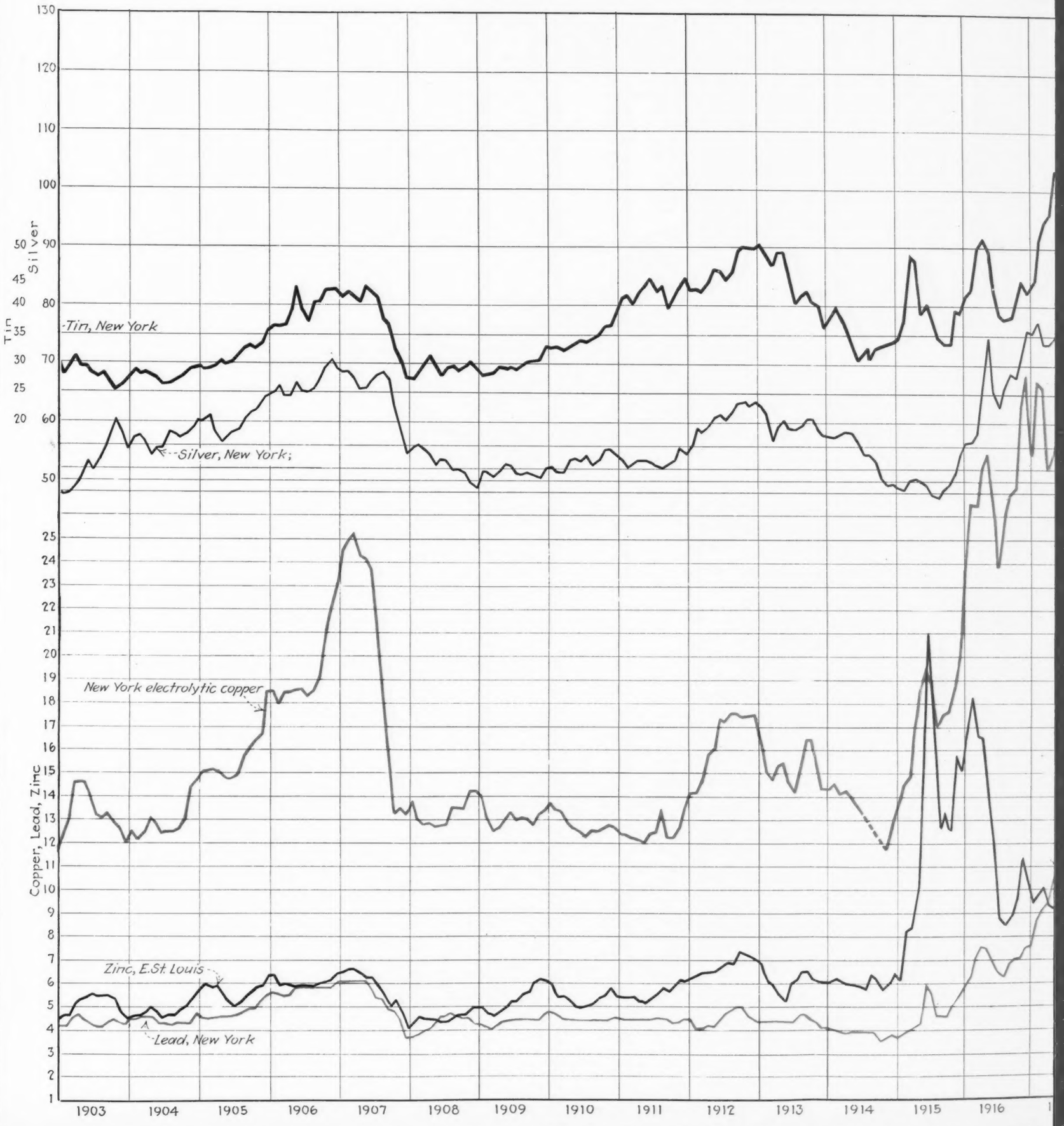
There is no distinct change in the general rate of mill operations from the December average, steel production now being at about 75 per cent of capacity.

Both in fabricated structural steel and in freight cars the new engagements since Jan. 1 are heavy, relative to last year's averages, but no definite pace is indicated by such a short-range comparison. No further decreases in steel demand are expected, seasonal increases being altogether more probable, but there is no disposition at present to predict that this year's total tonnage will equal that of last year.

Pig Iron.—Demand for Valley pig iron has been light. Bessemer remains quotable at $19.50. Basic can be had at $18, against the former nominal quotation of $18.50. In foundry iron small lots are now going at the $18.50 price formerly applicable only to large lots.

Connellsville Coke. — Spot furnace coke, $3.40@$3.65; spot foundry, $4.50@$5.

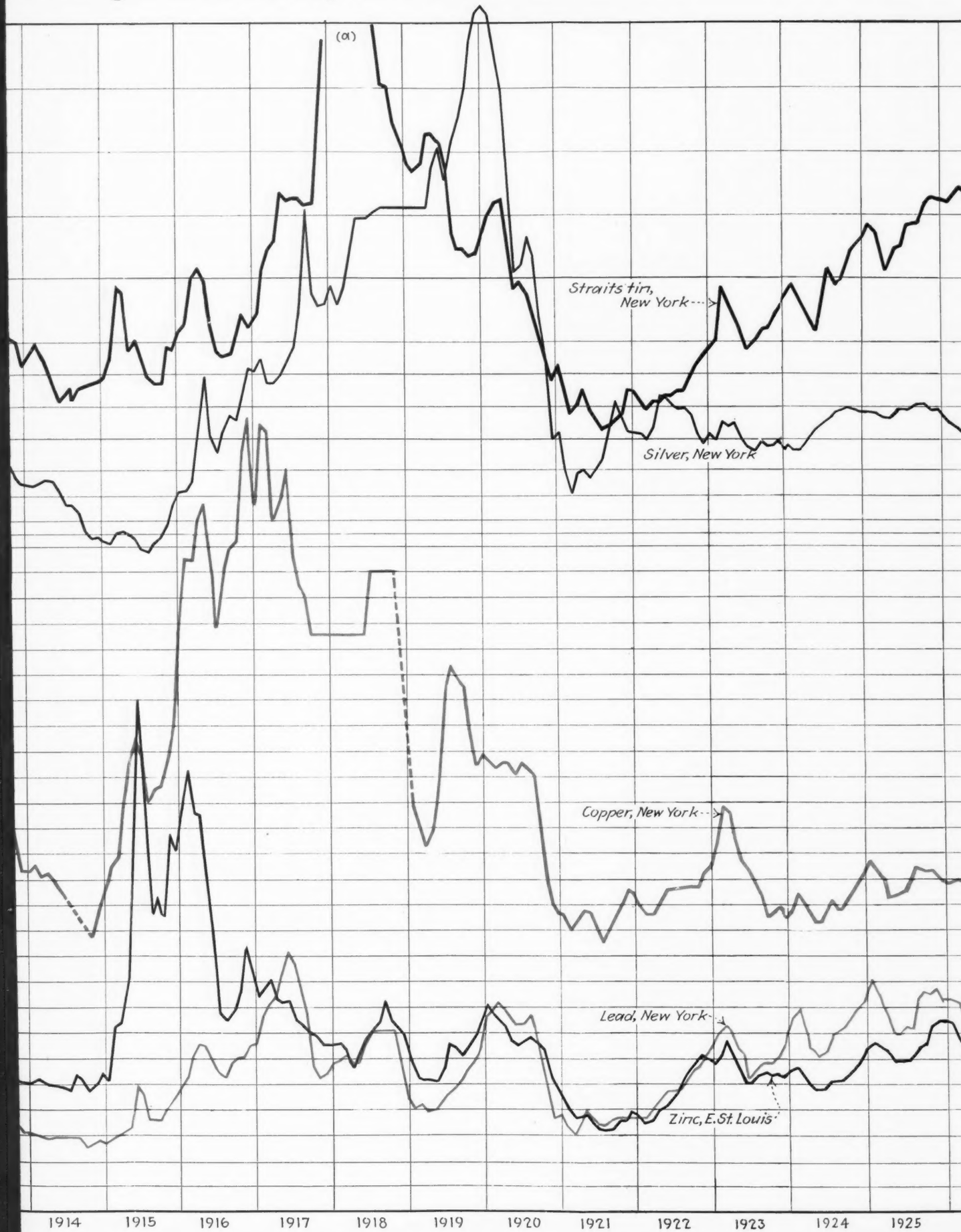
Metal Price Chart of Engineering and Min



(a) *No Engineering and Mining Journal quotations for this period*

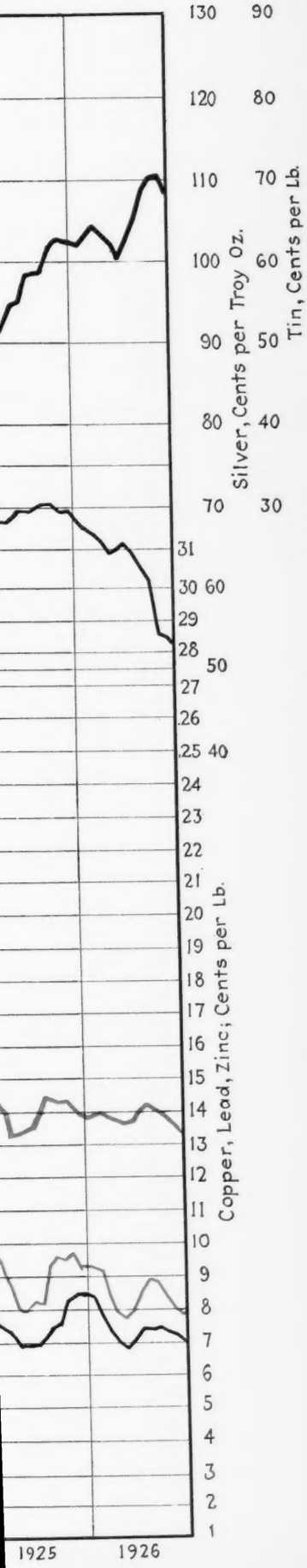
Prices of Copper, Lead, Zinc, Tin

neering and Mining Journal, 1903-1926



Lead, Zinc, Tin, and Silver

Supplement to Engineering and Mining Journal, Ja



Journal, Jan. 22, 1927